ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXIX. No. 7.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK..... 145

TECHNICAL ARTICLES:

Wire Rope Tramway at the San Juan Mines (*illustrated*)..... 146
Anti-Freezing Soda Mortar..... 146
Charles Storer Storrow (*portrait*)..... 147
A Colorado Silver Mine..... 148
Some Recent Examples of Monier Arch Construction (*illustrated*)..... 14
Ten Years' Growth in Mineral Products of the United States, 1880-1891 (*illustrated*)..... 149
Notes from the Engineering Schools..... 149
The Redwood Conduit of the Butte City Water-Works Co. (*illustrated*)..... 150
The American Type of Freight Cars for European Railways..... 150
New Office Buildings in Chicago (*illustrated*)..... 151
A 35-ton Traveling Crane for Harbor Work (*with inset*)..... 153
Strength of Boxed Pine Timber..... 154
Fuel Consumption of Webb Compound Locomotives 154
Reduction of Water Consumption by Meters..... 161
A Notable Concrete Building (*illustrated*)..... 162
Sewage Purification in America (*illustrated*)..... 163
The Dean Duplex Fire Pump (*illustrated*)..... 165
The Coffin Toughening Process..... 165
A Sanitary Urinal with Oil Seal..... 1 5

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS..... 154, 155

EDITORIAL NOTES..... 156

Our Industrial Supplement—The Panama Canal Trial—Strength of Bled and Unbled Pine Timber—Manufacture and Use of Aluminum.

EDITORIALS:

Letting Highway Bridge Contracts..... 157
An English View of American Railways and Locomotives..... 157

LETTERS TO THE EDITOR..... 158

Letting Contracts for Highway Bridges—A Thaw Box for Dynamite (*illustrated*)—Automatic vs Manual Block Signals—An English View of American Locomotives.

CONSTRUCTION NEWS..... 166-168

Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous Manufacturing and Technical, Current Price List.

The plans for the swing bridge over the Harlem Ship Canal have been informally approved by the Board of Estimate and Apportionment of the city of New York, and will at once be submitted to the Secretary of War. The total length of the bridge and its approaches will be 2,324 ft., and it is estimated to cost $2,000,000. On the south side there will be two approaches; one beginning in 130th St. and Lexington Ave., and the other in 129th St., between Second and Third Aves. There will be one approach on the north side of the River in Third Ave. The bridge will be built of iron and steel, and the approaches will be built of iron and masonry. The central swing span, which will be of steel, will be 300 ft. long, and each side of the draw will be 104 ft. in the clear. The bridge will have a width of 86 ft. The channel spans will be 26 ft. above high-tide mark. An electric trolley railway track will run across the bridge. There will be 6-ft. sidewalks on each side of the bridge, and on each side of the track there will be a roadway 15 ft. wide. The draw will be operated by steam.

The Winner bridge across the Missouri River at Kansas City, Mo., seems in a fair way to be completed after a suspension of work for nearly two years. The various properties, which went to the wall upon the failure of the Winner Investment Co., have been purchased and reorganized, and the new company will issue the bonds necessary to carry the work to completion. A description of the bridge was given in our issue of March 15, 1890. Including approaches, the structure will be 1½ miles long. The bridge proper consists of four 428-ft. spans, two 283-ft. spans and one 150-ft. span, supported on five pneumatic caisson piers and four piers founded without the use of compressed air. The superstructure was practically completed before the work was abandoned, and all contracts for the superstructure let.

The bids for dredging out the Philadelphia harbor, which work was described in our issue of Jan. 19, are again the object of discussion as to the ability of the successful bidder to perform the work in the time and manner required. As shown in our last issue, the lowest bid came from contractors unknown to the United States officers. Congressman O'Neill, of Philadelphia, and Senators McPherson, of New Jersey, and Higgins, of Delaware, favor the American Dredging Co., as being responsible, well known and fully equipped for the work. Major Raymond, the U. S. Engineer in charge, also recommends this company's bid, though it is $416,030 higher than that of Messrs. Coffey and Connelly, which was $2,987,750 for the work proposed. The matter is to be decided by Secretary of War Elkins.

The new Brooklyn Navy Yard dry-dock is to be lengthened to 670 ft., under the pending contract with John S. Gillies. The original plan and specifications called for a dock 600 ft. long, and on this the bid of $412,000 was based. Since the letting, the steamships "City of New York" and "City of Paris" have been admitted to the American register, and these and other ships to be built under the act of Congress of last July call for a greater length of dock. As the result of a conference with a board of engineers with Civil Engineer P. C. Asserson, U. S. N., at its head, Mr. Gillies has consented to accept the sum of $45,556 as compensation for the increased work. The new dock will be of the timber type, and is to be finished in 30 months.

The most serious railway accident of the week was the derailment of the New York express from St. Louis, on the Cleveland, Cincinnati, Chicago & St. Louis Ry. near Pana, Ill., Feb. 7. The accident occurred near a small trestle, and is attributed in press dispatches to a broken rail. The engine and tender passed in safety, but all the cars were derailed. The train consisted of a mail car, baggage and smoking car, express car, one day car and three sleeping cars, seven cars in all. The mail car caught fire and the whole train was burned. The baggageman was imprisoned in the wreck and burned to death, and 21 persons were injured, some seriously.——In a rear collision between a light engine and a gravel train at Espey Run, Pa., on the Lehigh Valley R. R., the caboose was smashed and one man was killed and eleven were injured. The engineman had orders to pass the gravel train at the next sidetrack, but was running at about 30 miles an hour.

A locomotive boiler explosion occurred Feb. 8 on the Tyler Southeastern R. R. at Tyler, Tex. The engine was standing at the station. Two men were killed.

A trestle on the Atchison, Topeka & Santa Fe R. R., near Baring, Mo., is reported to have given way under a passenger train Feb. 10. Two cars went down, but nobody was seriously hurt.

The orders given out by the Belgian State Railways are said to have done little to bring about any improvement in the state of the iron and steel markets, according to a report in "Industries," of London. Steel works have little work in hand and mills are quiet. Engineering establishments are, however, fairly well employed. The orders recently secured will permit of the number of unemployed, which is exceedingly great, being slightly reduced. During 1892 the Belgian government, which has at present an excellent occasion to complete the renewing of its railway equipment at moderate rates, is being urged to give out some orders, and is also being urged to reconsider the question of the use of iron or steel ties. The order for 30,000 tons of Sandberg's Goliath rails for the State Railways to be delivered within two years, has been divided as follows: Cockerill Works, 9,000 tons; Angleur, 5,700 tons; Ougree, 5,100 tons; Thy-le-Chateau, 5,100 tons; and La Louviere, 5,100 tons. The price for the rails is about $26 per ton. During 1892 Belgium imported from Great Britain 30,049 tons of pig iron, as compared with 41,212 tons in 1891.

Copper tube plates are giving trouble in the fireboxes of the locomotives of the Southern Mahratta Railway, India. At a recent meeting of the company the president stated that many instances had occurred recently of the copper tube plates of their locomotive engines having cracked. The cause had not been definitely ascertained, but he inclined to the opinion that it was due either to the escape of some gas from the firewood used on the line, or to some chemical in the composition of the water.

The Nova Scotia coal fields have been acquired by an American syndicate, headed by Mr. E. M. Whitney, of Boston. Mr. Fielding, the premier, has submitted to the Nova Scotia Legislature the terms of the contract with the Boston syndicate, which has purchased the Gowrie, Caledonia, Glace Bay, Ontario, Bridgeport and International coal mines in Cape Breton and the bounded properties of the General Mining Association and of the Sydney and Louisbourg (Cape Breton) English companies. The provincial government grants a lease for 99 years of the mines in Cape Breton Co. alone in return for a royalty of 12½ cts. per ton, guaranteeing a minimum revenue of $122,000. The syndicate will invest $7,000,000 in developing the mines, introducing modern methods of mining and transportation, and building a railway from Sydney to Louisbourg. Mr. Fielding, in submitting the contract, said that he preferred American to British capital for developing the mines, as the investment of American money would lead to a large increase in the general trade with New England. The next step in the matter, it is said, will be the establishment of a combination between the American syndicate and the Canadian owners of the Picton and Cumberland collieries regarding prices and output for the eastern Canadian market.

The mileage of the Pennsylvania system of railways on Dec. 31, 1892, was 7,979¾ miles, according to the official statement just received. This is an increase of 133.93 miles over the previous year. The trackage of the system on the same date was 14,278 miles, including 7,979.75 miles of first track, 1,514.95 miles of second track, 330 miles of third track, 187.97 miles of fourth track, and 4,265 miles of sidings. The increase in trackage during the year was 601.65 miles, nearly one-half of which was sidings. Thirteen states are now embraced in the system, but 79.3% of the total mileage is in the states of New Jersey, Pennsylvania, Ohio and Indiana. The greatest mileage, 3,128 miles, is in Pennsylvania, and the smallest mileage, 2.91 miles, is in Kentucky.

The State Engineer of New York, Mr. Martin Schenck, in referring to the proposed ship canal from the lakes to the Atlantic, says that aside from the enormous cost of such a canal, for construction, will be the question of water supply. If this supply is taken for the eastern section from the western water-shed of the Adirondacks, it will be at the expense of extensive manufacturing interests, which now receive their water from that region. Mr. Schenck thinks that the commercial ends of such a canal would be met by enlarging the present Erie Canal system so as to permit the passage of barge tows; each barge to be 250 ft. long, 25 ft. wide and drawing 10 ft. of water, and carrying 50,000 bushels of grain each. This improvement could be made at a very reasonable cost, as compared with the "half billion of dollars" which he believes would have to be expended in properly carrying out the larger and deeper ship canal, with its extensive locks, reservoirs, drawbridges, etc.

The time has come for a Metropolitan District for Boston and surrounding towns, says the Boston Park Commission in its last report to the Massachusetts Legislature. Legislation has been shaping itself to this end for some years, and the increase in rapid transit facilities, especially through the recent development of electric roads, has already made every town within 10 miles of Boston a close suburb. A great and increasing proportion of the inhabitants of these towns do business in Boston, and, except in name, they are inhabitants of both places. The Commission would include in this Greater Boston twelve cities of an aggregate population of 880,000.

Work is to be commenced at once on three of the five steamships that the Cramp Shipbuilding Co. is to construct for the American line. Four ships will be built from designs somewhat similar to the "City of Paris," each 511 ft. long, 63 ft. beam, 42 ft. deep, of 10,665 tons gross register and 14,538 tons displacement at 26 ft. draft. The contract speed is 20 knots. The peculiar feature of these four ships, which are to run between New York and Antwerp, touching at Southampton and Boulogne, is the reduced first-cabin capacity. Instead of carrying 780 first, 184 second and 386 third class, as in the "City of Paris," the new ships will have accommodations for 472 first, 216 second and 500 third cabin passengers. The fifth ship, however, is to run between New York and Liverpool and compete in speed, etc., with the new Cunard boats "Campania" and "Lucania." The plans are not complete, but every modern device is to be applied. More than 25,000 of the 31,000 tons of steel required for the new ships will be supplied by eastern Pennsylvania firms. The average price paid is $40 per ton, which Mr. Cramp says is lower than if they had been allowed to import all the steel duty free.

The Genesee water storage project, for a better supply of water to the Erie Canal, has been reported upon favorably by the State Water Storage Commissioners, Messrs. John Bogart, Charles McLouth and Evan Thomas. This commission recommends a 58-ft. dam across the Genesee River, near Mount Morris, covering about 1,400 acres of land, and storing 1,500,000,000 cu. ft. of water. This dam could be built so as to admit its height being increased to 100 or 130 ft., with a storage capacity of over three to five times that of the 58-ft. dam. The estimated cost of the dam designed for 100 ft. ultimate height is $1,350,000; and for 130 ft., $2,760,000. The territory to be flooded is sparsely settled, and land is worth $25 to $40 per acre. The 130-ft. dam would flood 2,350 acres, and back the water up the river for about 15 miles. The legislature must decide whether the dam be built for state use alone, or in conjunction with any other users of water.

WIRE ROPE TRAMWAY AT THE SAN JUAN MINES.

We illustrate herewith a wire ropeway of the running rope type, erected last summer at the San Juan mines, in Lower California, by the California Wire Works, of San Francisco. The running rope type of ropeway was invented some 23 years ago by Mr. A. S. Hallidie, of San Francisco, President

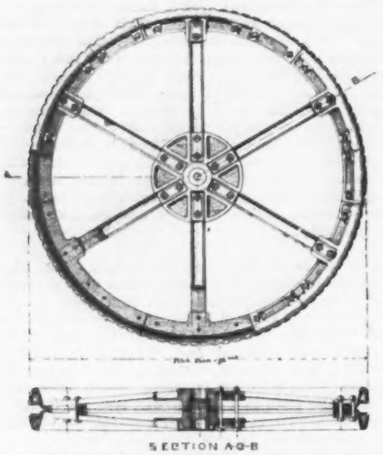


Fig. 1. Grip Pulley at Upper Terminal of San Juan Wire Rope Tramway.

of the California Wire Works, and an inventor who won prestige by his work in connection with the first cable railway lines, which were operated in the hilly streets of San Francisco.

There are a number of mines on the peninsula of Lower California in which American methods and machinery have replaced the old Mexican methods of working. The San Juan mines, owned by Cranz Bros. & Co., are situated in the mountains back of the Bay of Los Angeles, in lat. 29° N. and long. 37° W. in the midst of broken hills and deep gorges, where the wonder is that any one ever found them, and the greater wonder is how any one ever had the courage to undertake their development. Rich as the ore is in silver, it would scarcely pay to work, except for the aid of modern methods of mining, transporting and milling. Of course the transportation of the heavy ore has been a chief item in the cost of working. The mines are only 2½ miles in an air line from the valley where wagon transportation is available, but there is a vertical rise in this distance of 2,850 ft. The mule trail from the mines to the valley is 15 miles in length, and to transport 30 tons of ore from the mines to the valley required a train of 300 mules and 30 men. Besides the great expense of this method of transportation, there was more or less risk from Mexican brigands.

The ropeway, which has now done away with muleback transportation, is 13,260 ft. between ter-

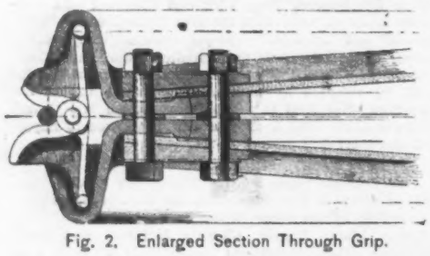


Fig. 2. Enlarged Section Through Grip.

minals. The upper portion of the line, 7,015 ft. in length, has a total fall of 2,375 ft., a grade of nearly 30%. The spans of the line are as follows:

No.....	3	41	2	5	2	16	3
Length, ft...	50	100	110	150	175	200	225

and one span of each of the following lengths: 250 ft., 275 ft., 400 ft., 725 ft., 1,210 ft.

On account of the very rugged country in which the ropeway was built, transportation of the materials for its construction was an important matter. The wire rope, ⅞ ins. in diameter, was shipped in lengths of 3,315 ft., each length being coiled in 19 double coils for mule transportation, sufficient slack being left between each pair of coils to permit the mules to travel without impediment. Thus a train of 152 mules was required for the transportation of the whole rope, and a novel picture was presented as this cavalcade wound up the steep, zigzag trails on the mountain side.

With the steep grades on this line, it will be readily understood that gravity alone is sufficient to operate it; the weight of the full ore buckets going down is ample to hoist the empty ones and keep the line running. The surplus of power is, in fact, such that all the supplies for the mine, rails, timber, brick, cement, hay, powder, etc., are carried up on the return side by the weight of the descending loads of ore. Thus these supplies, which formerly cost $10 to $30 per ton to transport up the mountain, are now carried free. The speed of the line is kept constant by a brake at the upper terminal.

The total weight of rope, machinery, bolts and all other material used in the construction, except the timber, was only 32 tons.

The general arrangement of ropeways of this type is doubtless familiar to most of our readers. The single rope used runs around a horizontal pulley at the terminal stations, and over vertical pulleys at the intermediate stations. The carriers are attached to the rope by clips, and run continuously, being loaded as they pass the upper terminal, and unloaded automatically at the lower terminal. The grip pulley and clip used on this line are recent inventions of Mr. Hallidie, and were patented last year, the pulley patent being No. 483,442, and the clip patent, No. 466,880. In the grip pulley, the principal modification from the older forms has been the abandonment of the pocket for the grips, and the introduction of a continuous groove in the periphery of the pulley. Figs. 1 and 2 are illustrations of the grip pulley. The new clip consists of a thin steel leaf, which surrounds the rope, and

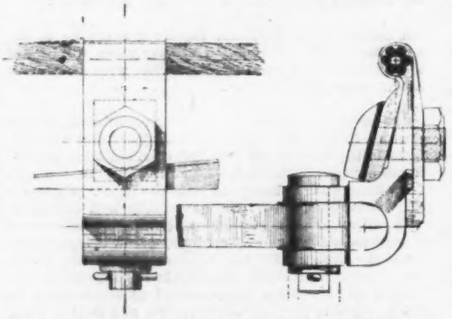


Fig. 3. Clip Used on San Juan Wire Rope Tramway.

which can be tightened when necessary, or can be easily removed and a new piece substituted. Tests of the load necessary to bend this clip have been made, and a load of 2,000 lbs. has been found necessary to cause a permanent set in the shank.

The San Juan ropeway was erected under the direction of Mr. E. I. Parsons, who has for nine years been Constructing Engineer for the California Wire Works. Among other remarkable ropeways erected under his direction, is one near the city of Guadalajara, Mexico, which has a clear span of 2,267 ft., and crosses a gorge 1,200 ft. deep. The natives took the precaution to have this line blessed by the parish priest before it began operations Another line of very steep grades is now being erected by Mr. Parsons at Monte Cristo, Wash.

Another interesting Mexican tramway of the Hallidie type was described in our issue of March 21, 1891, and a tramway of the standing rope type at Howland, Me., was described April 2, 1892. The interested reader may refer also to our issues of Jan. 1 and Oct. 29, 1887.

ANTI-FREEZING SODA-MORTAR.

In the last issue of "Le Genie Civil" Mr. Charles Rabut, Engineer of the Western Ry., of France, gives his experience in handling mortar for masonry in freezing weather. He says that the company of which he is engineer has tried mixing alcohol and marine salt with water, and finally adopted the ordinary soda of commerce. This latter gave the best results in reducing the liability of the mortar to freeze; and in the winter of 1891-92 a considerable amount of masonry of all kinds was laid on the line even in a temperature of 5 to 14° F. above zero. Among the works executed was an arch of 50 ft. span, with the masonry laid up in lime mortar without cement.

From his experience, the following rules for mixing the soda with the mortar have been adopted: He used the anhydrous carbonate obtained by the Solway process, as it costs less for transportation and hand-labor than the carbonate hydrate. This soda comes powdered, in sacks

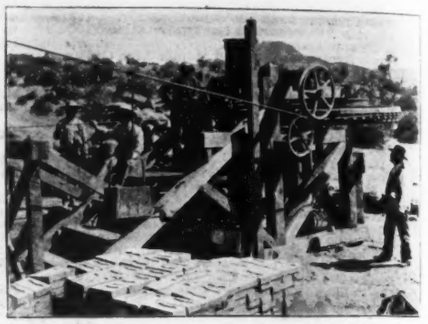


Fig. 4. Upper Terminal of San Juan Wire Rope Tramway.

It is dissolved in a kettle in which is constantly maintained a dosage of one kilogram (2.2 lbs.) to 5 litres (5¼ qts..) of water at a temperature of 30° C. (86° F.) This solution is mixed with an equal volume of ordinary water in the tubs from which the masons obtain the water for the mortar. One kettle of 10 litres capacity will serve 10 masons. The final dosage is thus one kilogram of carbonate of soda to 10 litres of water, and it is used at a temperature of 50 to 53° F. In the preparation of the mortar, the proportion of water usually employed in a mortar of 1 part sand to 1 of lime ought to be increased about one-quarter. Sand frozen on the surface should be carefully pulverized, and it is well to provide the workmen with rubber gloves.

The increased expense of using the soda in lime mortar of the usual proportions is, per cubic metre of masonry (1.3 cu. yds.), about as follows:

10 kilos carbonate at 4 cts.	$0.40
2 " charcoal, at 0.8 cts.	0.016
Materials. . .	0.01
1 hour hand-labor	0.07
Total. . .	$0.496

Fig. 5. Looking Up San Juan Wire Rope Tramway from Station 42.

(The tramway passes up the hill and through the notch in the middle of the skyline.)

This increased cost, of about 37 cts. per cu. yd., at French prices for labor and material, may be neglected when compared with the augmentation of general expenses and the other inconveniences

which follow the interruption of work of this character by cold weather, says Mr. Rabut.

Mr. Rabut says that the addition of the soda not only makes it possible to mix the mortar and to preserve it in a low temperature, but it also hastens the setting. With the proportion above given, the soda mortar, submitted to a temperature of 23° F., the setting has been at least twice as prompt as with the same mortar without the soda at a temperature of 14° F. above zero. At the surface, for a depth of .16 to .20 in., the hardening is much quicker. The interior, during the setting process, remains humid. This has been proven by pulling down masonry after five months, and when exposed to the air the mortar dried rapidly.

These results have been obtained with masonry exposed to the air. With the mortar immersed in water strongly impregnated with soda the set has been much accelerated. The use of soda causes white blotches to appear on the surface of the masonry; but these disappear after some months. This fact and the persistent humidity of the interior, practically forbids use in front of buildings; but it may be used in all other works.

CHARLES STORER STORROW.

The American Society of Civil Engineers has honored itself even more than it has honored Mr. Storrow by his election to honorary membership in that society, as announced in another column. The world moves so fast nowadays that after a man has once retired from active practice, as Mr. Storrow did many years ago, he is apt to be forgotten, even in his own profession; and hence to many of the present generation of engineers even the name which heads this article may be entirely unfamiliar. Yet Mr. Storrow played a great part in the early days of American civil engineering, and is now almost, if not quite, the most eminent living representative of our earlier civil engineers, and was the first, and for many years the leading American hydraulic engineer. In our issue of Sept. 1, 1892, we have already given some facts of his professional life, but the following more detailed sketch will be read with interest:

Mr. Storrow was born at Montreal, Canada, March 25, 1809, and he is therefore now almost 84 years old. His parents were residents of Boston, and his father a merchant of Boston and a close friend of the eminent engineer Loammi Baldwin.

He graduated from Harvard in the famous class of 1829, ranking first in his class. Among his classmates were the poet Oliver Wendell Holmes, James Freeman Clarke, the astronomer Benjamin Pierce and Judge B. R. Curtis. During his senior year and during the six months after graduation he studied from Mr. Baldwin's library, at that time probably the most complete engineering library in the country.

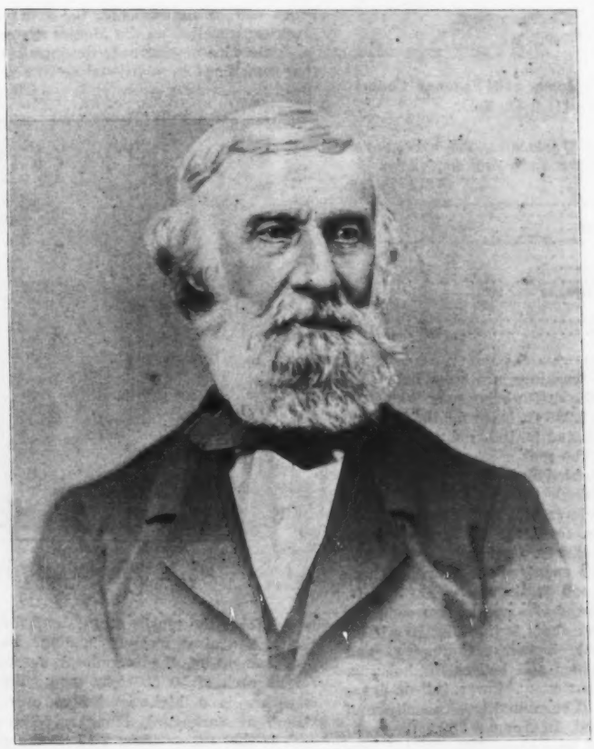
About Dec. 1, 1829, Mr. Storrow sailed for France, and studied at the Ecole des Ponts et Chaussees. Through the friendly influence of Lafayette, he also obtained permission to attend lectures at the Ecole Polytechnique. His studies in France were continued until the spring of 1832. Meanwhile he visited England to study works of engineering, particularly the Liverpool & Manchester Ry., then building under Geo. Stephenson, and thus, when he joined the Boston & Lowell R. R., was the only engineer engaged on the work who had ever seen a railroad or a rail.

He returned to America in the spring of 1832 and at once began as assistant engineer on the Boston & Lowell R. R. (the earliest of the New England steam railroads), then building under James Baldwin, and, upon the completion of this road, he became its first manager. For nearly ten years he continued manager of this railroad.

In 1835, soon after his return from France, Mr. Storrow published "A Treatise on Water-Works." This was largely a transcription of the theories of flowing water as elucidated by De Prony, Du Buat, Belanger and the other early French hydraulicians, and was a most excellent and complete textbook of hydraulics, so far as understood at that day. This was probably the earliest general treatise on hydraulics in the English language, although detached hydraulic problems were to be found treated in the works of Smeaton, Leslie and others.

Although the later experiments of Francis, D'Arcy and others, have modified many of the coefficients and changed some of these earlier conclusions, this work of Mr. Storrow's remains a remarkably clear exposition of hydraulic principles, and is noteworthy for the clearness, completeness and elegance of mathematical analysis throughout, and for the completeness with which each branch of the science is treated. In every way it appears to be a most remarkable work to be published on hydraulics 57 years ago, and one in which we may feel a national pride as having been written by an American engineer.

Soon afterward, and while he was still manager of the Boston & Lowell, he was employed by the "Locks and Canals Co." to measure the water used by the mills at Lowell, and he made the first scientific measurements of the sort ever attempted in this country. Upon the completion of that task he advised the "Locks and Canals Co." to employ young Mr. Francis for their further work in that direction, and Mr. Francis, as is well known, remained with them until his recent death.



Yours very truly
Chas. S. Storrow

In 1844, encouraged by the early success at Lowell, the Lawrences and other prominent merchants and capitalists of Boston became interested in the creation of a manufacturing city ten miles farther down the Merrimac, where rapids existed. A thousand or more acres of farm land had been purchased, and Mr. Storrow was selected as engineer to plan and execute their works, and to manage the enterprise, and himself became a stockholder. As engineer, he personally designed the granite dam, which is 33 ft. high, with a 900-ft. overfall, and which to this day is probably the most magnificent milldam in the world; the canal, 100 ft. wide by a mile in length, and other structures. At the same time he planned the arrangement of the streets for the future city, and so far as might be the class of buildings for which each should serve. Meanwhile he also was financial manager of the enterprise, and for a time he directed the construction and financial management of some of the large factories which the Essex company had contracted to build. When the new city received its charter Mr. Storrow was elected its first Mayor in recognition of his services in the founding of the city.

Mr. Storrow retained the general management of the Essex company until his retirement from business a few years ago, and for nearly 40 years directed with rare judgment the development of the large property in lands and water power created under his care. This left little time for engineering work outside, and the planning of Lawrence, Mass., and the development of its water power may be regarded as the life work of Mr. Storrow.

In 1862, at the request of the state of Massachusetts, whose citizens were becoming almost discouraged over the long delay in the completion of the Hoosac Tunnel, Mr. Storrow visited France to examine into the use of compressed air for drilling and facilitating tunnel work. Through the friendly assistance of his old classmates he was afforded unusual facilities for examining the works of this kind in France, especially at Mont Cenis, and his report and advice was of much service to the state. He was also the engineer member of the Massachusetts State Commission of 1861 on the flowage and drainage of the Sudbury and Concord meadows; and planned and executed a hydraulic survey of those water courses and of the flow in their crooked and weedy channels.

Mr. Storrow and Dr. Oliver Wendell Holmes are now, we believe, the only two survivors of the famous "Boys of '29," whom Dr. Holmes has made immortal by his annual class songs. The whole world will wish them both many years of life.

A COLORADO SILVER MINE.

Silver is an extensive mineral product of the United States, and its output, as shown by the diagram in another column, has increased from 30,320,000 troy ounces in 1880, 39,910,279 oz. in 1885, to 58,300,000 oz. in 1891. Colorado is the most important silver producing state, its output in 1890 having been 18,800,000 oz., Montana coming next with 15,750,000 oz., and the total output of that year being 54,516,300 oz.

The Enterprise silver mines, near Rico, Colo., make a good showing for the year ending September, 1892. The output was 8,906 tons of ore, with an average assay of 1.348 oz. of gold, 135.928 oz. of silver and 3.48% of lead, equal to 12,005 oz. of gold, 1,201,738 oz. of silver and 619,890 lbs.

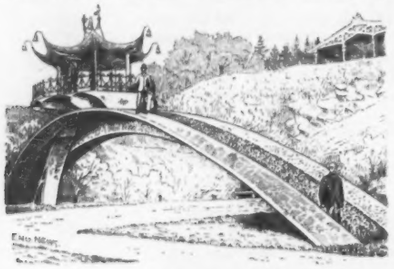


Fig. 2. Examples of Monier and Rammed Concrete Arches; 114.8 Ft. Span.

of lead, all valued at $1,000,257. The average cost per ton of obtaining the above was as follows:

	Per ton.
Mining	$23.84
Supplies	2.02
Sampling and assaying	1.23
Hauling	1.04
Fuel	.86
Freight	.65
Development	10.77
Office and legal expenses, taxes, etc.	1.27
Total expenses	$41.68
Value	112.31
Net profits	$70.63

The underground workings are very extensive, the total length of the drifts being over 30,000 ft. The Group tunnel is 1,935 ft. long; for the first 300 ft. it is in loose sand, and is timbered, with a clear section of 4×7 ft. The rock section is about 6×8 ft. The tunnel is lighted by electric lamps about 100 ft. apart, has a single track of 12-lb. rails, and drains the entire underground workings, having a box draw 10×12 ins. for 1,200 ft. It is proposed to drive the tunnel 1,000 ft. further. The principal buildings are near the mouth of the tunnel. There are two shafts, 4½×9 ft. in the clear, 363 ft. and 500 ft. deep; the shafts are in two compartments, and the deeper shaft is lined by 10×10-in. timbers. The plant includes Champion and Knowles pumps, engines and boilers for hoisting, dynamo and fan, a Sturtevant blower, Edison dynamo for 65 lamps, etc. The ground breaks easily and the ore is easily mined. In August, 1892, the number of men employed was about 180, divided into

Fig. 3. Monier System Applied to Stairway Construction

two shifts of 10 hours each. Mr. Leo Van Rosenberg, of New York, in a description of the property, says that while the ore bodies produce large amounts of very rich ore, often averaging between $300 and $500 per ton, and sometimes even higher, the best test is the average value of the ore mined during the year, which, as already stated, showed an average value of $112.31 per ton, with a net profit of $70.63 per ton. The mines are owned by the Enterprise Mining Co., of New York. President, Lloyd I. Seaman; Secretary and General Manager, George Crawford; Superintendent, Daniel Kirby.

SOME RECENT EXAMPLES OF MONIER ARCH CONSTRUCTION.

In our issue of May 23, 1892, we published a general description of the Monier method of constructing long-span arches of concrete by imbedding within it a network of wires to supply the defect in the tensile strength of that material, and gave illustrations of some actual arches constructed on this principle. At that time the method had been but recently applied to long-span arches, although it had been used for some time for arches of short span, and the system was yet in the process of development. Since then, however, considerable progress has been made in the general application of the principle; formulas have been calculated for the mathematical computation of the strains, and the practical application of the method made to several important structures, some of which are shown in the accompanying illustrations, which we reproduce from a recent issue of "Stahl and Eisen."

As will be remembered, the general method of arch construction on the Monier system is to place a single wire netting near the intrados of the arch, but sometimes an additional netting is used, placed near the extrados, when it is considered necessary

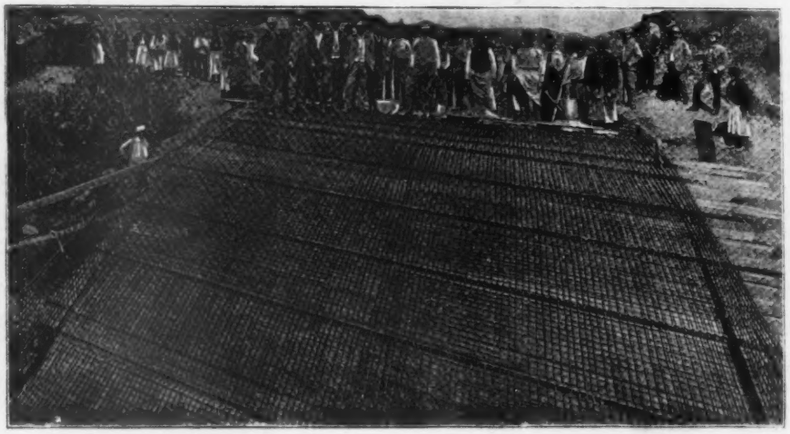


FIG. 1. ARRANGEMENT OF THE NETTING FOR A 50-FT. SPAN MONIER ARCH.

to reinforce the tensile strength of that portion of the arch against unequal loading. In Fig. 1 the arrangement of the intradosal netting is shown for an arch of 50 ft. clear span. This particular structure is a highway bridge over the Nador Canal, at Sarbogard, Hungary. The rise of the arch is 7.06 ft., or about 2-17 of the span, and its thickness at the crown is 7.9 ins. The netting is shown supported by the sheathing of the center, ready for the application of the concrete. In Figs. 2 and 3 is shown another arch with a span of 114.8 ft. and a rise of 13 ft., having a uniform thickness of 3.9 ins. throughout. By its side is placed a rammed concrete arch, having a uniform cross section of 1 sq. m. The two arches support a pavilion constructed of concrete on the Monier method. The application of the same method to the construction of stairs is also well shown in these illustrations. A highway bridge over the Nagold River, near Altensteig, Black Forest, Germany, is shown in Fig. 4. This bridge has a span of 65.6 ft., and a rise of 8.2 ft., and the thickness of the Monier arch at the crown is 7.9 ins. The Monier system has also been used in the construction of sewers at Hamburg, Germany. A cross-section of one of these sewers, showing the manner of arranging the wire netting, is shown in Fig. 5.

Some tests of the strength and stability of arches constructed on the Monier system were given in our former article; these, it will be remembered, showed very favorable results. Doubts as to the advisability of the general introduction of the system in engineering construction were, however, expressed. The principal objections brought forward were: (1) That the wire would eventually corrode by coming into contact with the moist concrete; (2) that the concrete would not adhere to the smooth surface of the iron, and thus the two materials would not act together, and, (3) that the iron wire would expand and contract under changes

Fig. 4. Monier Arch Highway Bridge; 65.6 Ft. Span.

of the temperature at a different rate than the concrete, and thus cause cracks in the latter material.

In refutation of these objections, the company pointed to the successful operation of its system in various structures, and advanced several experimental proofs. In reference to the first objection, it was shown that the wire imbedded in a concrete plate, which had been immersed in water for months, not only did not exhibit signs of rust, but retained its original blue color, while in another plate, the protruding ends of wires 9-32 in. and 13-32 in. in diameter were entirely eaten away, and the covered portions were unaffected. To demonstrate the adhesion of the concrete and iron, experiment was made with a wire 9-32 in. in diameter, imbedded in a baluster which had been exposed to the weather for ten years. An attempt to pull the wire from the concrete resulted in its rupture under a tensile strain of 2,866 lbs. The great adhesion of the cement and iron is attributed to a chemical connection between the silicate of the cement and iron. In regard to the third objection, experiments with the Monier plates

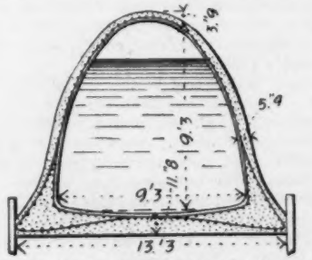


Fig. 5. Monier Sewer Section, Hamburg.

showed that the contraction and expansion of the iron wire, even under the extremes of cold and heat, did not fracture the inclosing concrete. The average value of the coefficient of Portland cement concrete, according to Bouniceau is 0.0000143 for a change of temperature of 1° C., and that of iron is 0.0000145, or practically the same.

TEN YEARS' GROWTH IN MINERAL PRODUCTS OF THE UNITED STATES—1880-1891.

The graphical exhibit here given is prepared from the report on the mineral products of the United States for the years 1880-1891, as issued by Mr. David T. Day, Chief of Division of Mining Statistics, Department of the Interior. For the purpose of starting all of these products from a common base line, the unit of quantity is given on each individual line of product; this unit, multiplied by the vertical scale gives the totals for each year. To make this plainer, we give the same products for the years 1880, 1885 and 1891 in tabular form, as follows:

	1880.	1885.	1891.
Pig iron, long tons.	3,375,912	4,044,525	8,279,870
Copper, pounds....	60,480,000	170,962,607	295,810,076
Lead, short tons....	97,825	129,412	202,406
Zinc, short tons....	23,239	40,688	80,337
Silver, troy ounces..	30,320,000	39,910,279	58,300,000
Gold, troy ounces..	1,741,500	1,538,376	1,604,840
Aluminum, pounds.	0	283	150,000
Nickel, pounds.....	329,068	277,904	118,498
Pa. anthracite coal, long tons.....	25,580,189	34,228,548	45,236,902
Bituminous coal, long tons.....	38,242,641	64,840,668	105,291,721
Petroleum, barrels.	26,286,123	21,847,205	54,291,981
Cement barrels....	2,072,943	4,150,000	8,222,792
Lime, barrels.....	28,000,000	40,000,000	60,000,000
Salt, barrels.....	5,961,060	7,038,653	9,987,945
Phosphate rock, long tons.....	211,377	437,856	587,988
Asphaltum, sht. tons.	444	3,000	45,054

In the above, long tons equal 2,240 lbs., and short tons 2,000 lbs. The coining value of the silver per troy ounce is taken at $1.2929, and that of gold at $20.6718. The totals of the various mineral products, including many not put upon the graphic exhibit here given, are as follows, for the years named:

	1880.	1885.	1891.
Non-metallic..	$173,279,135	$241,312,093	$356,216,615
Metallic.....	190,039,865	181,586,587	302,307,922
Unspecified, estimated value.....	6,000,000	5,000,000	10,000,000
Grand totals...	$309,319,000	$427,898,680	$668,524,537

NOTES FROM THE ENGINEERING SCHOOLS.

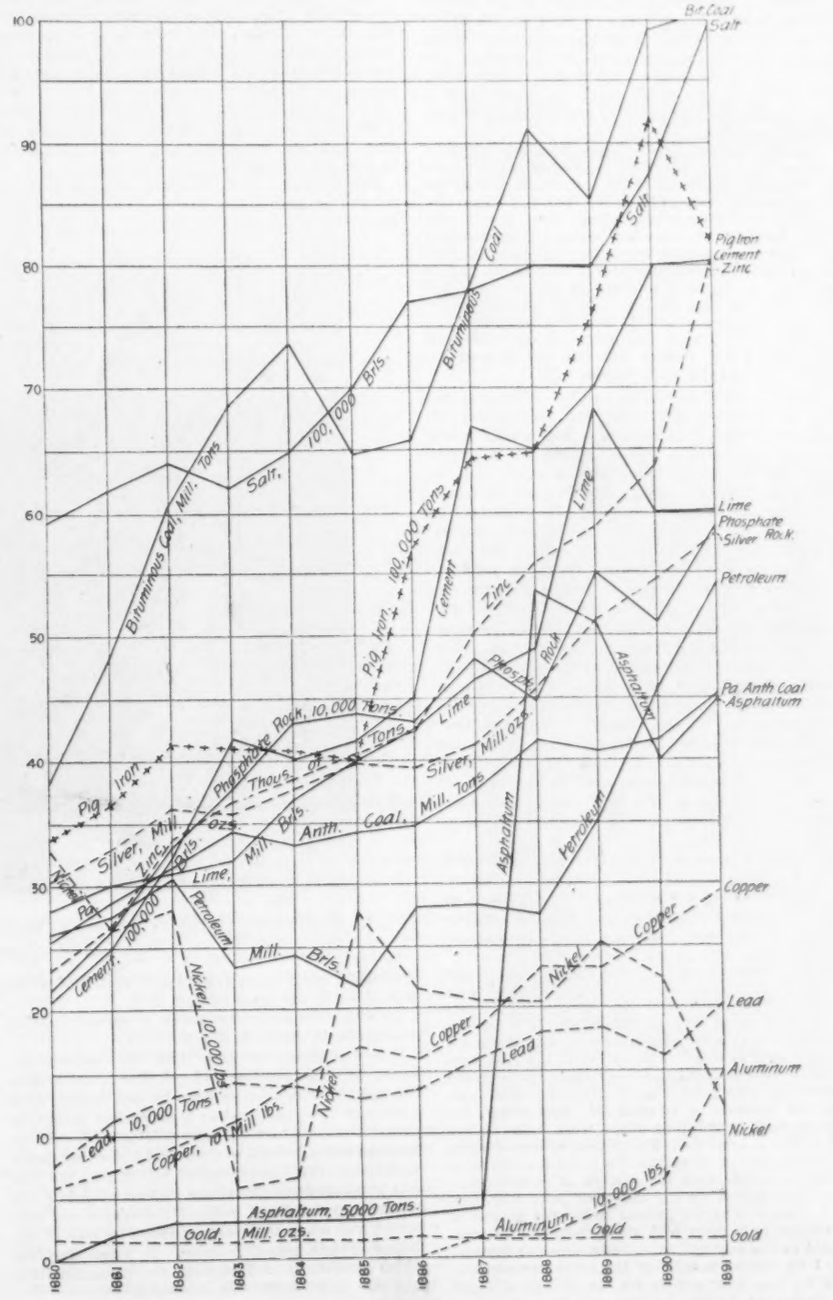
As we announced last week, in the concluding article of our series on engineering schools, we shall hereafter carry along a department of this journal under the above head, in which we shall endeavor to chronicle all the more significant changes in the schools, so far as they come to our knowledge, and from time to time to give also comparative statements of single facts in respect to all the schools at once. For instance, we shall hope to collect annually or biennially the total number of graduates from all the schools, to show how engineering education, as a whole, is advancing in importance, and how the graduates are distributed in respect of location and the several departments of engineering. We shall also hope to give shortly a diagram showing for every day in the year just which schools are in session and which are not, and various other facts of that kind which can be collected without throwing too great a tax upon the several professors or upon the editor.

We trust that some one person at least at each of our engineering schools will take sufficient interest in the purpose of this column to keep us advised in regard to any significant changes of purpose or methods which may occur at his college. We shall by no means attempt to chronicle all facts of possible interest in regard to every college or any college; nor will this department appear in every issue of this journal; nor will it attempt to cover completely any kind of college news, except in the specific instances referred to where special information may be collected by circular. It is hoped, however, to make it sufficiently complete to enable any one who reads it habitually to keep pretty well informed as to the "stream of tendency" at our engineering schools; in what respects they are advancing and in what retrograding. It is hoped also that the department may serve as a kind of forum for discussion, or as an information exchange in regard to the engineering schools, and to this end a considerable part of its contents are likely to consists of letters to the editor.

In the beginning at least this will be true, as we have quite a collection of letters which have been waiting publication as corrections of or comments upon the facts heretofore given in the series of articles just concluded. Some of these are the following. Others will appear next week.

Professor Monroe, of the Columbia College School of Mines, comments as follows, very justly, on the unfairness of considering the course at Columbia as only 32 weeks long, without considering also their required vacation work, in which they differ from most of the other schools, which require no vacation work. We fully agree that the required vacation work below described is likely to be at least as profitable to the student as any equal time spent in studying. He needs both, and cannot dispense with either without loss. Neglect duly to recognize this fact, indeed, we think to be one of the greatest remaining defects of our engineering schools.

I must protest against the course at Columbia being considered as of 32 weeks only. I think that the summer schools, averaging 6 to 8 weeks, should be counted, and at their full value. Until lately I have had charge of the summer classes in surveying, and I know that the men work quite as hard as in the termtime, and more hours per week. In the winter, the required attendance is from 10 a. m. to 5:30 p. m.; or deducting the half hour allowed for lunch, 7 hours per day. If we add 2½ hours preparation, we have a total of 9½ hours. In the summer schools, the boys spend 9 hours in the field, and average 2 to 2½ hours in the evening in computing, or 11 to 11½ hours daily. These figures show 1½ to 2 hours daily, or 7½ to 10 hours per week more work in the summer than in the winter. And it is not fair to say that the summer work is a relaxation, nor to count the summer work at half or one-third the value of the winter work. Of the 45 weeks which you credit to the Houghton Mining Schools, but 28 weeks are occupied by lectures and recitations; the remaining 17 weeks are laboratory and field work. These spring and summer terms,



INCREASE IN OUTPUT OF THE MINERAL PRODUCTS OF THE UNITED STATES, 1880–1891.

so called, are really summer schools. In comparing the Michigan School with the Massachusetts Institute of Technology, you have given these 17 weeks full weight. In your colored diagram you have credited Columbia with about eight weeks surveying, instead of 20 weeks, the time actually given to the work.

I think, also, that you have given us too much chemistry and too little mathematics. As to these errors, you will doubtless hear from Professor Hutton.

If we have "credited Columbia with about eight weeks surveying instead of 20 weeks, the time actually given to the work," it is because the return was so made to us. Whose fault is it? This question of the distribution of time to the several studies is conspicuously one of those on which we hope to obtain fuller and more correct information, as we recognize that what we have received and given was by no means what it should have been.

Director M. E. Wadsworth, in forwarding a copy of the last catalogue of the Michigan Mining School, remarks:

You will find numerous changes from our course of the preceding year, especially in an effort to reach more practical instruction and to elevate our standard as far as practicable. You will observe that this school has very rapidly increased in numbers. Since the opening of the fall term 91 students have been enrolled, which is almost five times as many (mining students.—Ed.) as the Massachusetts Institute of Technology had in 1891, and is over twice as many as Columbia has this year. We look upon this as a seal of approval set by the people upon our efforts to give a more practical mining education than the other schools apparently undertake. I can further say that the demand for our pupils is greater than we can suply.

As Columbia College also has had a large accession to its mining class this year, and reports the outlook as most encouraging, it may easily prove that the depression in the mining schools in recent years as shown by the numbers graduated, is only a temporary incident, due in part or whole to the sudden increase in demand for graduates in mechanical engineering, and the practical creation of a demand which never before existed for graduates in electrical engineering. We can perceive no reason why there should not be a large demand for graduates of mining schools, if properly managed, nor why mining is not as promising a field as any for young men to enter on. Certainly it has not the disadvantage of civil engineering, that so large a proportion of the men in it have to be the employees of large and soulless corporations, in which the individual is almost lost. But still, the number of civil engineering graduates has somehow grown all the time, despite mechanical and electrical competition, which has not been the case with mining. We shall watch with especial interest the future course of events in this respect.

President Adams, of the University of Wisconsin, in his report of Jan. 4, 1893, comments as follows on the growth of the engineering department of that university, following it by a demand for $34,000 worth of new buildings and experimental plant:

The department of the university that is growing most rapidly is the college of mechanics and engineering. The number of students in this college is this year 30% greater than ever before. There is reason to anticipate a still larger increase next year. The buildings now used as shops were erected in the year 1885-86. They were designed to accommodate at the utmost 75 students. Our present number is 173. Next year there will probably be at least 225. Fortunately, the buildings now occupied as shops were built with a special view to extension. The present accommodations for the departments of engineering in science hall were likewise provided when the number of students pursuing these studies in the university was only one-fourth what it is at the present time. The growth of this college, in common with all institutions of a similar kind in the country, has greatly exceeded expectation. I am unable to see how the temporary arrangements we may now provide for can furnish adequate accommodations for the classes more than about two years. This fact, together with the very definite prospect that the natural sciences, with physics and psychology, will soon demand all the room in science hall, forces us to confront the certainty that at an early day we shall be obliged to mature plans for a separate engineering building of large size.

The Case School of Applied Science, of Cleveland, O., which two years ago had hardly begun to give instruction in engineering, has organized the four engineering courses, and four other allied courses in chemistry, physics and architecture. It now has a faculty of 16 instructors, headed by Prof. Cady Staley, and being richly endowed with lands which must continue to rise in value, and well situated otherwise, must in time assume a prominent place.

THE REDWOOD CONDUIT OF THE BUTTE CITY WATER-WORKS CO.

In our issue of Jan. 5, 1893, there appeared a description of a 24-in. redwood water supply conduit, about nine miles long, recently built for the Butte City Water-Works Co. by the Excelsior Wooden Pipe Co., of San Francisco, Cal. Since the article was published we have received from Mr. D. C. Henny, Manager of the Excelsior Wooden Pipe Co., some photographs taken during the construction of the conduit, three of which we reproduce herewith.

Fig. 1 shows a compound curve in the conduit at a change of grade, and is a good illustration of the ease with which the pipe may be laid to conform to the natural surface of the ground.

Fig. 2 shows a 24 to 20-in. reducer, and also shows very plainly how the hoops or bands of ½-in. steel rods are fastened around the conduit and the malleable, iron clip, or fastening, a sketch of which was given in our issue of Jan. 5.

FIG. 1. COMPOUND CURVE IN REDWOOD WATER CONDUIT, BUTTE CITY, MONT.; Excelsior Wooden Pipe Co., San Francisco, Cal., Contractors.

An 8-in. blow-off, for which a special casting was made, is shown in Fig. 3.

Other photographs sent, but not reproduced, show: (1) The bending and painting of the fastening rods, the rods being bent by one man around a circular form mounted at a convenient height, to permit the man to walk around it as he bends the rod, one end of which is made fast before the bending begins. (2) The process of building up the conduit in place from the single staves; all joints are broken and the front ends of the staves are supported and given their proper shape by one of the fastening rods, placed in loose. (3) Back cinching, which consists in retightening the fastening rods.

The Public Works Department of Chicago, Ill., asks for $5,969,135 for use in the coming year. Of this amount $1,845,637 is appropriated for streets, with $887,442 of this to be expended for street cleaning. Bridge construction calls for $1,014,447; sewer construction and maintenance, $308,320; Chicago harbor, $262,100; new pumps at the canal pumping works, $105,000. The street cleaning estimate is based on a cost of $22.50 per mile for sweeping and cleaning 3,437 miles of improved streets for 9 months, making a total of 30,933 miles. For cleaning 26 times a year 193 miles of macadam streets, a total of 5,618 miles, the estimated cost is $25 per mile for the total mileage.

THE AMERICAN TYPE OF FREIGHT CARS FOR EUROPEAN RAILWAYS.

The advantages of long freight cars of the American type for bulk freight on European railways have often been pointed out, both in this country and abroad, and the tubular frame cars of this type, now manufactured in England, were described in our issue of April 28, 1892. The "Engineering Review," of London, makes a comparison of the working of coal traffic for the Milan Gas Works with the ordinary small cars and the long American cars, much in favor of the latter. Coal is hauled from Genoa to Milan, Italy, 98 miles, in cars weighing 6½ gross tons, and carrying 10-ton loads of coal. The tubular frame cars weigh 11 tons, and carry 30 tons of coal, and it is estimated that by the use of these cars the railway company will make 34½% more profit than it now makes on the gas traffic, and that the gas company will save 26% of its freight charges. This is based on the assumption that the railway company will permit the use of the long cars on its line, and will allow its present rate for hauling coal from Genoa to Milan to be distributed over dead load and live load, including the return of the empty cars. The cost of operation of these long cars is estimated to be only half that of the present short cars, 48 cts. per ton per mile for operating expenses, against 96 cts. for the short cars, while the cost with the long cars on the Norfolk & Western R. R. is given as 36 cts. per ton per mile. It is stated on the authority of Mr. Jefferds, inventor of the tubular frame cars, that in addition to these cars in England and Ireland, there are 774 on the Belgian State Railways, 800 on the Northern Railway, of France (which railway is also building 50 more, which are 52 ft. 6 ins. long); 35 on the Italian State Railways, and 120 have been ordered for Germany. In a letter in the same paper, Mr. Jefferds states that there are two great faults in the construction of long cars on trucks in England, which are among the reasons why such cars are not liked there. In the first place, the center-bearing plates are made flat, or if ball-shape the concave plate is on the truck bolster, and the convex plate on the body bolster, both flat and round, having king bolts. "If a load of timber or rails, for instance, is placed on a car having trucks with flat center-bearing plates, and it should experience a collision, the load would shift with the curved plate; the socket fills with dust and dirt, and prevents easy action. The center-bearing plates should be round, with the convex plate over the truck bolster, and the concave plate on the body bolster, like

our hip joints. Dust or dirt will work out of these, and they require lubricating only twice each year. In a collision a load will not shift with these bearing plates. The lifting process in getting the concave plate over the convex, or, in other words, trying to unjoint it, takes up a far greater percentage

FIG. 2. REDUCER, 24 TO 20 INS,, IN REDWOOD CONDUIT.

of the shock than one would naturally imagine." As to the side bearings, he says these should be ⅜ in. in the clear between the body and truck bolsters on each side when the car is empty. In English construction the side bearings are made to touch, so that the wheels are rigid the whole length

Fig. 3. Eight-Inch Blow-Off in Redwood Conduit.

of the car, while by allowing clearance the trucks are free to take any curve regardless of the body of the car.

Whatever may be the advantages of the short cars for convenience in the rapid handling of freight in small quantities, which is one of the special features of English freight service, there can be no doubt that they are capable of considerable improvement, and that for bulk freight, such as coal, ore, salt, lumber, grain, etc., as well as for large shipments of any kind of freight, the long American cars are far superior to the short cars.

Telephone communication between Boston and Chicago, 1,200 miles, was formally established on Feb. 7. The line worked satisfactorily.

NEW OFFICE BUILDINGS IN CHICAGO.

Chicago this year will be on exhibition, and a specially interesting feature of it will be the tall "sky-scraper" type of building for offices and business purposes, in which Chicago leads the world, and is likely to continue to do so from the necessities of the situation, as explained in our issue of Oct. 13, 1892, in discussing "The Chicago Foundation Question." Our foreign friends, especially, who may visit Chicago and the World's Columbian Exposition, will be amazed at the contrast between Chicago and any other city in the world in this respect. The architecture is really not a very difficult task, as the designer is strictly limited. He must keep within certain dimensions, and he must make available every possible square foot of floor space. Much monotony of form, therefore, is unavoidable; yet some of these tall, rectangular buildings are impressive and pleasing in appearance, while others are unpleasing and awkward, frequently from too much breaking up of the vertical surfaces, or from a fantastical style of finishing off the top with domes, turrets, pediments, and other ill-placed features, which do not harmonize with the simplicity of the lower portion of the building. We do not set ourselves up as critics of architectural design, but, speaking as laymen, the Columbus Memorial Building, Fig. 1, is perhaps as fine an architectural example of the art how not to do it, as could be found; and as such we give it.

The structural design of these immense buildings is a matter of great importance, requiring careful study of each individual case, and comparatively few architects care to undertake this part of the work. This has led some engineers to make a specialty of the design of ironwork for such buildings, and in our issues of Dec. 5, 12 and 26, 1891, and Jan. 2 and 9, 1892, were given details of the construction of some of the tall Chicago buildings, with skeleton steel framing, firebrick flooring and partitions, and an outer masonry casing or curtain to form the sides of the building, for which we were indebted chiefly to Messrs Purdy & Phillips, one of the leading firms in that line. The foundations, also, call for careful consideration, and the steel "spread" foundations adapted in several cases were described and illustrated in our issue of Aug. 8, 1891, while the general question of Chicago foundations was discussed in our issue of Oct. 13, 1892, as aforesaid, in which issue was illustrated a type of deep "well" foundation proposed by Gen. William Sooy Smith.

A considerable amount of building of this character was done in 1892, and several buildings are now being completed. We are indebted to Mr. C. T. Purdy, of Chicago, and to some of the architects mentioned, for views and particulars of the large office buildings erected in the business center of that city during 1892, referring only to buildings now being made ready for occupancy, or which are to be ready by May 1. The list includes the structures described in the present article, which will illustrate the present tendencies in building construction in Chicago. Mr. C. T. Purdy designed the steel construction of the Boyce, Columbus, Ellsworth, Katahdin, Lees, Old Colony and Wachusetts buildings, as consulting engineer for the architects, and there are interesting features in connection with some of these buildings, which we cannot now consider in detail.

Boyce Building.—This is located at 112, 114 Dearborn St. It is 40 ft. 8 ins. front by 90 ft. deep; is 160 ft. high, with basement, 12 floors and an attic, and has about 39,000 sq. ft. of renting area. The main design is gothic, with steel and fireproof construction. The building is for office purposes, with stores on the first floor, and has compartment vaults on each floor for the use of tenants hiring offices without vaults. There are three elevators, and the usual equipment of steam heating, electric lighting, etc. Architect, Henry Ives Cobb. Contractor, C. Everett Clark.

Columbus Building, Fig. 1.—Situated on south-

Fig. 1. Columbus Building; Architect, W. W. Boynton.

east corner of Washington and State Sts. It is 90×100 ft., less area of court, 33×43 ft., in one corner, has 14 stories, and is 244 ft. high from sidewalk to top of tower lantern. The design is in the style of the Spanish renaissance, and, as before stated, appears to us a poor specimen of American architecture, judging from the accompanying cut, Fig. 1, while it is to have the accessories of illuminated globes, etc., which are advertised as attractions. The construction will be of steel and fireproof material, with elaborate interior finish. The two lower stories will have bronze fronts, above which the exterior will be of yellow terra cotta. Some of the floors are arranged for stores, others are entirely undivided, and the upper seven floors are arranged for consultation and reception rooms for medical men, while on the top floor are a medical library, 21 ft. × 29 ft. 9 ins., and an octagonal room for a museum, 26 ft. 9 ins. diameter.

There will four elevators, and all steam, water and sewer pipes will be contained in recesses in the columns. Historical paintings and a statue of Columbus will be included in the decoration. Architect, W. W. Boynton. Contractor, Geo. A. Fuller Co.

Ellsworth Building, Fig. 2.—Situated on Dearborn St., 50 ft. north of Harrison St., and runs through to Plymouth Place. It is 75×70 ft., with 54,000 sq. ft. of renting area, has 14 stories and basement, and is 170 ft. high from sidewalk to top of roof. The general appearance is shown in Fig. 2, and the architectural treatment is very simple. Cut stone is used for the lower three stories, and red brick with terra cotta trimming for the upper stories. The trimmings were supplied by the American Terra Cotta Co. The interior construction is of steel, with Z-bar columns. There are three elevators. The halls are wainscoted 3 ft. high; the interior is of brick, with cabinet finish, and the halls have marble tile floors. The building is for general office purposes. Architect, John M. Van Osdel. The Carnegie Steel Co. supplied and erected the steel.

Hartford Building.—Situated on the southwest corner of Madison and Dearborn Sts., having frontages of 48 ft. and 90 ft., respectively. It has basement, 14 stories and attic, with about 60,000 sq. ft. of renting area, and is 165 ft. high. The architectural treatment is classic and the construction is of steel, similar to that of the Boyce Building. The first three stories will be occupied by banks or stores, and the remainder by offices, most of which will have outside light. There will be four elevators. Architect, Henry Ives Cobb. Contractor, C. Everett Clark.

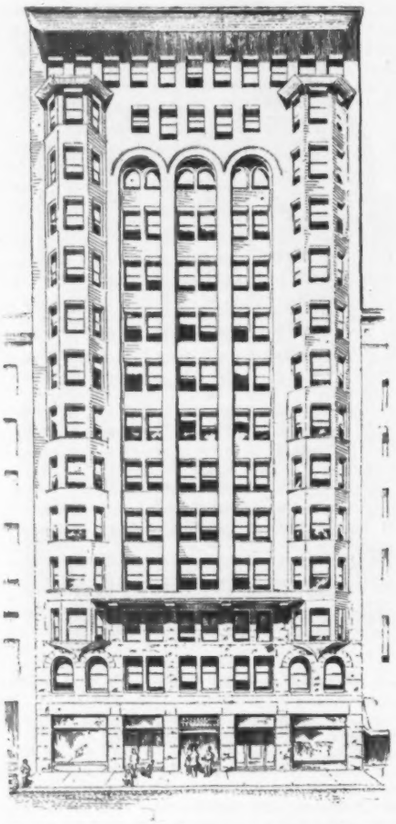


Fig. 2. Ellsworth Building; Architect, John M. Van Osdel.

Isabella Building.—Situated on Van Buren St., between State and Wabash Sts. It is 45×76 ft., with 10 stories, and is 110 ft. high from sidewalk to cornice. The construction is steel, with brick and terra cotta outer walls. Architects, Jenney & Mundie. Contractor, Whitney & Starrett Co.

Katahdin Building.—Situated on Dearborn St., between Jackson and Van Buren Sts., adjoining the Wachusetts Building, described later. It is 66×100 ft., with 17 stories, and is 200 ft high from sidewalk to top of roof. Architects, Holabird & Roche. Contractor, Geo. A. Fuller Co.

Lees Building.—Situated on Fifth Ave., between Madison and Monroe Sts. It is 80×115 ft., with 12 stories, and is 141 ft. high from sidewalk to top

Fig. 5. Y. M. C. A. Building, Chicago; Architects, Jenney & Mundie.

of roof. It is a very substantial brick structure, extremely plain on the exterior, thoroughly fireproof; built in the typical skeleton steel type. It was originally intended for the wholesale trade, but will be probably largely rented for offices. Architect, James Gamble Rodgers. Contractor, Geo. A. Fuller & Co.

Marshall Field Building, Fig. 3.—This is on the northwest corner of Washington St. and Wabash Ave., adjoining the old Marshall Field Building. It is 109×151 ft., with an interior court, 39×64 ft. It has nine stories, and is 153 ft. high from sidewalk to top of roof. It is a retail store and office building and the first, second, third and fourth floors will be occupied as a store, while the upper floors are used for offices. It is expected to be an entering wedge for the retail trade on Wabash Ave. It is probably the costliest building of the size and the kind in the city. The exterior is of marble up to the third floor, and above, a light terra cotta. While not so high as some of the other buildings, it is eminently pleasing in appearance, and will be a very handsome structure. The interior is to be magnificently furnished and fitted. The main support in the exterior walls, back of the facing of terra cotta, is massive masonry, and the interior steel work is very heavy and in keeping with the rest of the construction. Architect, D. H. Burnham. Contractor, Geo. Fuller Co.

Old Colony Building.—This is on the southeast corner of Dearborn and Van Buren Sts. It is 68 ft.×148 ft., with 17 stories, and is 215 ft. high from sidewalk to top of roof. The design is very simple in treatment. Architecturally it is divided into three stages, the first being the lower three stories, the second being the next eleven, and the third being the 15th and 16th stories and the attic. The whole is surmounted with a heavily molded and bracketed cornice. Each corner is treated with a circular bay, with an interior diameter of 13 ft., extending from the third floor to the cornice. The windows of the east and west fronts are arranged in five panels, extending from the third floor up through the second stage, the intermediate pilasters accentuating the main supports of the building. The main entrance will be in the center of the Van Buren St. front, and will be 30 ft. wide, with a lintel supported near each side with a monolith column 26 ft., or two stories, high.

The first three stories will be of dressed blue Bedford stone, the remaining stories of white brick, with semi-glazed white terra cotta trimmings, and the attic of white terra cotta only. The brick are long and thin, called Roman brick, and are close and hard in texture. They come from Philadelphia, and it is expected that Chicago smoke will soil them, though they are too hard to absorb soot to any extent. It is designed to scrub the building every year or two. Special provision has been made in the steel framework to resist wind pressure. To secure extra security in fireproofing, although the walls will consist in part of 16 ins. of brick; there will be intersposed between this brick and the steel work a sheath of hollow tile.

Just within the Van Buren St. entrance is a vestibule, 20×28 ft. and two stories high, with a staircase at each side leading to the banking rooms on the second floor. From this vestibule a hallway, 19 ft. wide, runs to the south end of the building. There will be six large fast-running hydraulic elevators. The building will be divided so as to make from 300 to 500 offices, according to the plan of subdivision, the first two stories being designed for banks. The floors, which Tiffany is designing, will be mosaic; the wainscoting of Italian white marble; the woodwork, oak. Large windows are a commendable feature of the design. Architects, Holabird & Roche. Contractor, Geo. A. Fuller Co.

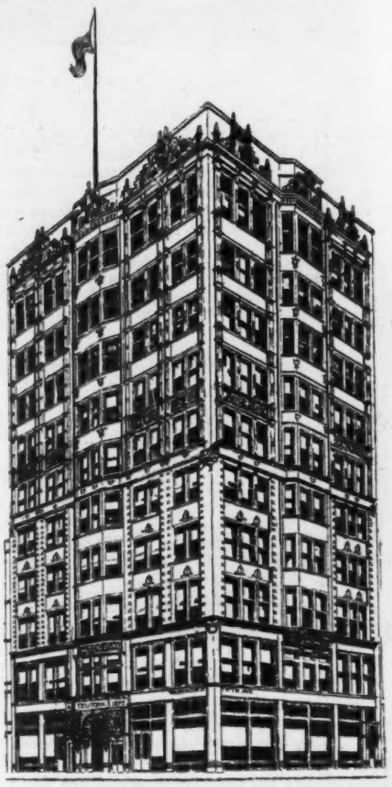


Fig. 4. Teutonic Building; Architects, Handy & Cady.

Security Building.—The building of the Security Deposit Co. is on the southeast corner of Madison St. and Fifth Ave. It is 46½×100 ft., and 200 ft. high, with a renting area of 46,200 sq. ft., two-thirds of which is already rented. The building is of steel and fireproof construction. The equipment will include four elevators, a safety deposit vault on each floor, letter chutes, gas and electric light in all offices, and toilet rooms, etc., on each floor.

Architect, Clinton J. Warren. Contractors, Angus & Guidel.

Teutonic Building, Fig. 4.—Situated on the southeast corner of Fifth Ave. and Washington St. It is 60 by 81 ft., with court 16×40 ft., and is 138 ft. high from grade line to top of cornice. The style is that of the German renaissance. The exterior is of terra cotta to the top of the second story window sills, and brick and terra cotta above. The foundations are of steel rails and beams on concrete (Eng. News, Aug. 8, 1891), and the columns are built up of plates, channels, and angles. The floor beams are generally 12 ins. deep, and the allowance for load on columns is about 8,500 lbs. per sq. in. Wind bracing is confined to the exterior walls. There will be a restaurant in the basement, stores on the first floor, and offices above. Marble wainscoting will be used, and the entrance will be finished in marble, while mosaic floors will be used in the corridors. Architects, Handy & Cady. Contractor, C. Everett Clark.

Wachusetts Building.—Situated on the northwest corner of Dearborn and Van Buren Sts., adjoining the Katahdin Building, already referred to. It is 66×100 ft., with 17 stories, and is 205 ft. high from sidewalk to top of roof. Mr. Purdy states that the Katahdin and Wachusetts buildings are being built as one building, and when completed will cover the southern half of the block, the northern half of which is occupied by the Monadnock Building. The interior construction is arranged so that when the two new buildings are complete, the corridors will be opened the entire length of the three buildings, making to all intents and purposes one building, 420 ft. long, 66 ft. wide, and bounded by four streets. The two buildings are of the same size, designed by the same architects, and are being constructed by the same contractor. They are, however, owned by different parties, and are entirely different in their exterior construction, although alike in outward appearance.

The exterior walls of the Katahdin Building are supported by massive masonry piers, some 7 ft. thick at the level of the first floor, and constructed of special vitrified brick, laid in cement mortar. The exterior walls of the Wachusetts Building, on the other hand, are supported by steel columns in the typical Chicago style. The great care exercised in fireproofing the steel in this building is worthy of note. The exterior columns are inclosed in fireproofing tile, and outside of the tile are 12 ins. of solid brick masonry, making exterior columns 4 ft. square in the finished size. It is stated that, so far as known, no other building of this character of construction has ever been equally well fire-proofed. This construction extends to the eighth floor, above which the fireproofing of the exterior columns is lighter. The two buildings are a good example of how completely alike the exterior appearance of the two kinds of buildings can be made. It would be impossible for one who did not know to tell which of the buildings had a solid exterior masonry construction and which was of steel skeleton type. The steel work in both of these buildings is of very heavy type throughout. Architects, Holabird & Roche. Contractor, Geo. A. Fuller Co.

Y. M. C. A. Building, Fig. 5.—Situated on the southwest corner of La Salle St. and Arcade Court. It is 54 ft.×190 ft. on the alley. There are 12 stories, and the height is 168 ft. It is of steel and fireproof construction, with exterior of terra cotta, cut stone and brick. It has a swimming bath, 24×72 ft., an auditorium and large gymnasium. It will be used for general office purposes. Architects, Jenney & Mundie. Contractor, Geo. A. Fuller Co.

FIG. 3. MARSHALL FIELD RETAIL BUILDING, CHICAGO; Architect, D. H. Burnham.

The great steel tower to be placed in Wembley Park, London, has been contracted for with the Stockton Malleable Iron Co. The "Engineer" states that this tower is to be 1,150 ft. high above the base, which latter will rise 162 ft. above the ground level.

A 35-TON TRAVELING CRANE FOR HARBOR WORK.

(With inset.)

The crane here shown was used for depositing blocks of artificial stone in the construction of the mole for the new port of Ponta-Delgada, in the island of San Miguel, one of the Azore Islands. The heaviest blocks weighed about 35 tons, and measured 15.6 ft. long by 5.25 ft. wide and thick; they were deposited at a distance of 30 m., or 98.4 ft., from the axis of the tower carrying the crane proper. Blocks of 12 and 15 tons were placed at distances of 164 ft. and 147 ft., respectively, from the center of revolution. The track upon which the crane moved had a minimum curvature of 325 ft.

The crane itself was made up of two girders spaced 7.2 ft. apart on centers. The total length is 170.5 ft., measured from the center of the crane-tower, and this is counter-balanced by a loaded pair of girders measuring 91.8 ft. in length and carrying a counterpoise made up of masonry, and weighing 113 tons. The height of the crane is 19.68 ft. at the center, decreasing to 11.15 ft. at the end; the verticals are box-form, made up of four angles and two plates, and the diagonals are flat bars, proportioned to the strains exerted in each panel.

The usual type of crane is designed to carry the chariot supporting the lifting chain and pulley on the upper chord, with the disadvantage of rendering impossible all lateral bracing of the two girders, in the path of the load. In this case, with a placing wing of great length, it was indispensable that the two girders should be firmly tied together; and if the carriage had been placed on the top chord, a double system of chains would have been necessary, passing outside the two girders, and the number of pulleys thus required would always have been objectionable. To avoid this trouble, Mr. Seyrig, the designing engineer, placed his carriage on the lower chord, which was made deep and strong inside for the track (see Fig. 5), and above the 7.54 ft. required for the movement of the carriage the two girders were cross-braced in the usual form. The result of this arrangement was to lower the center of gravity of the whole structure, and thus to augment its stability.

The crane revolved upon a circular track, 26.24 ft. in diameter, upon conical rollers, as shown in Figs. 3 and 4. The tower supporting the crane (Fig. 2) is 26.24 ft. square and 39.36 ft. high from rail to bottom of the crane; it is braced in the two directions, as shown, and leaves a clear passage 13.94 ft. high beneath for the free circulation of the trucks carrying the blocks. In the direction of the track on which the tower moves, this tower is strongly braced by four framed angles connected with the posts and a prolongation of the bottom beams. Under each bottom beam is an adjustable support which almost touches the roadbed, the purpose of which is to provide an immediate support to the tower in case of any sinking in the roadbed or the accidental breakage of a truck wheel.

The trucks supporting the tower are also peculiar in this design. There are four trucks with four wheels in each; but to better insure the equal distribution of the load upon the wheels, these trucks are balanced. The center balance beam is connected with a collar fastened to the lower plate of the posts, in such manner as to permit the passage over curves in the line. At the ends of this center beam are articulated two other double balance beams carrying the journals for the wheels. The wheels are 2.95 ft. in diameter, with a central flange and two bearing tires. Eight of these wheels, wedged upon their axles, carry the linked chain used in hauling the load.

The carriage for transporting the blocks is composed of two vertical cheeks of iron plate, spaced 1.64 ft. apart, and held by strong braces and carried on four wheels, 2.64 ft. in diameter, 4.6 ft. gage and 4.26 ft. apart on centers of axles. These axles pass through the cheek plates, which are reinforced so as to give a sufficient bearing. Four clamps are riveted to the cheek pieces in such manner that they can be attached to the rails by means of screws, so as to render the carriage immovable at any desired point. Beneath the carriage and suspended from the axles, are the two pulleys for the lifting chain and two smaller guide pulleys for this chain. Before and behind the carriage are two forged iron hooks attached to the cheek pieces, and between these is carried a bal-

lanced bridle, to which the chains for moving the carriage are connected.

The operations of moving the crane-tower, turning the crane, moving the carriage and lowering the blocks, are performed by steam. The engine is vertical, with two cylinders of 9⅞ in. diameter and stroke, with 200 revolutions per minute. The power, as applied, is about 65 HP., and all movements are under the control of the engine driver, stationed on the crane itself. We are indebted to "Le Genie Civil" for the original from which this matter is prepared.

STRENGTH OF "BOXED" PINE TIMBER.

It has been a generally accepted opinion that pine timber that has been "boxed" to draw out the resin and turpentine is less strong and durable than timber from unboxed trees. Investigations on this point have been made by the Forestry Division of the Department of Agriculture, with the result that it has been shown that no such deterioration is caused by the "boxing" or "bleeding" process, as noted in our editorial reference to the government timber investigations in our issue of Jan. 26.

In a circular of the Forestry Division, published about a year ago (Eng. News, April 2, 1892), it was stated that tests made on timbers of longleaf pine, bled or unbled, lent countenance to the belief that bled or tapped timber did not suffer in strength by virtue of the tapping, and in a circular recently issued it is stated that further tests and examinations permit now the announcement without reserve that the timber of longleaf pine is in no way affected by the tapping for turpentine. This refers to its mechanical as well as chemical properties, and hence even the reservation that it might suffer in durability is now eliminated and any prejudice against the use of bled timber in construction, wherever the unbled timber has been considered desirable, must fall as having no foundation in fact, being based only on vague belief, proved to be erroneous. This fact should be made widely known among builders, architects, and engineers who have hitherto made discrimination against bled timber and thereby depreciated or discouraged the manufacture and impeded the sale of an article which answers all the purposes of construction, and the unrestricted use of which is dictated by true economy.

The basis for the statement regarding the mechanical properties is furnished by a series of tests comprising not less than 300 tests on 32 trees of this pine, bled and unbled, from various localities. The somewhat puzzling fact that bled timber exhibited, if anything, greater strength in the tests has been accounted for by the fact that the turpentine orchards are located mostly on sites which produce better quality timber as well as larger yield of turpentine. To determine whether any changes in the chemical composition take place, a series of chemical analyses of bled and unbled timber has been made, which indicates that the resinous contents of the heartwood are in no wise affected by the bleeding, the oleoresins of the heartwood being non-fluid, the whole turpentine flow is confined to the sapwood.

Among other interesting facts regarding the distribution of resinous contents through the tree which will be published in a separate bulletin, it appears that trees standing side by side, and to all appearances in similar conditions, show very varying quantities of resinous contents. To make sure that experience did not, if sifted down, contradict the results of these investigations, a competent agent, Mr. F. Roth, visited turpentine orchards and saw mills in the longleaf pine region. He reports that nobody was found able to discern any difference in the appearance of the bled and unbled timber (although this ability was claimed by some); that in spite of consumers' specifications for unbled timber, they are almost invariably served with a mixture without finding it out; and that experience in the districts where unbled timber is cut and used has not sustained the claim of inferiority.

This information has been issued by Mr. B. E. Fernow, Chief of the Forestry Division, in advance of the full report on the investigations in question in order to remove as quickly as possible the unwarranted and mistaken discrimination against the product of nearly one million acres of southern pine, which are annually added to the total acreage in turpentine orchards. This result of authoritative investigation should be worth several millon dollars to the forestry interests of the South, permitting readier use and sale for a product that left uncut endangers the future of the forest by the destructive conflagrations to which it is specially subject.

FUEL CONSUMPTION OF WEBB COMPOUND LOCOMOTIVES.

The average fuel consumption of all the compound locomotives in use on the London & Northwestern Ry. during their whole period of service has been 35.1 lbs. of coal per engine-mile. These compounds are of the three-cylinder type, invented by Mr. F. W. Webb, Locomotive Superintendent of the London & Northwestern Ry., and one of them was illustrated in our issue of Jan. 26, 1889. The first locomotive of this type was turned out April 3, 1882; the last Oct. 30, 1891. The total number built is 85. The average fuel consumption of the different classes has been as follows:

Wheel diameter....	6 ft.	6 ft. 6 ins.	7 ft.
Lbs. coal per mile...	38.1	32.2	35.4

We take the above information from a letter by Mr. Webb published in "Locomotive Engineering." It must be remembered in comparing these figures with those of American roads that English trains are much lighter than those in this country.

PERSONALS.

Mr. Chas. S. Storrow, of Boston, Mass., has been elected an Honorary Member of the American Society of Civil Engineers. A portrait and sketch of his life appear in another column.

Mr. C. F. W. Brass has accepted a position in Pittsburg, the office of chief draftsman, which he filled with the Youngstown Bridge Co., having been abolished.

Mr. L. P. Pairo has been appointed Master of Trains of the Alabama Division of the East Tennessee, Virginia & Georgia Ry., vice Mr. E. T. Horn, transferred; Mr. Pairo will have headquarters at Selma, Ala.

Mr. Arthur H. Johnson, Engineer of Signals on the New York, Lake Erie & Western R. R., has resigned his position, having been appointed Consulting Engineer of the Hall Signal Co. and the Johnson Railroad Signal Co.

Mr. Rudolph Hering, M. Am. Soc. C. E., of New York, has been engaged by a special committee of councils and citizens of Colorado Springs, Colo., to plan a new system of water-works distribution, with proper fire service for the city.

Mr. Alfred P. Boller, M. Am. Soc. C. E., delivered a lecture before the students of the Rensselaer Polytechnic Institute, on Feb. 9, on the substructure and approaches of the new highway bridge over the Harlem River, at 155th St., New York.

Mr. Frank L. Sizer, of the engineering firm of Sizer & Keeri, Helena, Mont., has accepted the position of chief engineer of the irrigation inquiry in the Agricultural Department, at Washington. He has been Chief Engineer of the Cascade Land Co.

Mr. W. Howard White, M. Am. Soc. C. E., formerly of 74 Wall St., New York, having found it expedient to move with his family to a milder climate, has taken up his residence, and opened an office as consulting engineer, at Redlands, San Bernardino Co., Cal.

Maj. Richard Randolph, Consulting Engineer, died suddenly, in Baltimore, Md., on Feb. 9, while reading in the Mercantile Library, of that city. Major Randolph was the engineer in charge of the Valley and Metropolitan branches of the Baltimore & Ohio R. R., and was until lately the engineer of the Belt Tunnel. He was made consulting engineer of the latter road a few months ago.

Mr. Joseph L. Lowry, Hydraulic Engineer, died at his home in Allegheny, Pa., on Feb. 11. Mr. Lowry was mechanical engineer for the new $7,000,000 water-works of that city, and designed the engines for these works, machines which caused considerable controversy among hydraulic engineers at the time. He was the inventor of the well known Lowry fire hydrant, which is extensively used; and also invented a steam fire-engine, both of which came into practical use.

Mr. William L. Saunders, M. Am. Soc. C. E., engineer and secretary of the Ingersoll-Sergeant Drill Co., of New York, will in all probability be re-elected to his present position of mayor of Plainfield, N. J., as the unanimous choice of both political parties, says the Plainfield "Courier." By his engineering knowledge he has already well served the citizens of Plainfield in many ways, notably in prescribing the rail section of the new electric railway, before a franchise was granted, and as the subject of sewerage is now a prominent issue there is evidently more good work to be done by the engineer mayor.

Mr. William G. Primrose, for many years Superintendent of Bridges of the Baltimore & Ohio R. R., died at Baltimore, Md., Feb. 11, at the age of 67. The first iron bridge erected on the Baltimore & Ohio was constructed in 1848, under Mr. Primrose's supervision. The old iron in this structure has been brought back to Mount Clare, and a model of it is now being made for the Baltimore & Ohio R. R. exhibit at the World's Columbian Exhibition. He built the bridge over the Monongahela, in 1853, which was destroyed by the Confederates in 1863. He rebuilt it at that time, and again in 1885. He had charge of the construction of the bridge at Harper's Ferry, which was begun in 1862 and not completed till 1870.

Dr. Norvin Green, President of the Western Union Telegraph Co., died at Louisville, Ky., Feb. 12. He was born in 1818. In 1854 he became interested in the telegraph business, and in July of that year he was one of those who leased the New Orleans & Ohio Telegraph Co. Soon afterward this company was incorporated under the name of the Southwestern Telegraph Co., and Dr. Green was made President. It built new lines on the railways running from Louisville to New Orleans, and the system was extended throughout Arkansas and Texas. The Southwestern Telegraph Co. was taken into the American Telegraph Co. in January, 1866, and in July following, the American Telegraph Co. was consolidated with the Western Union Telegraph Co., of which Dr. Green was elected President in 1878.

Prof. William H. C. Bartlett, on the retired list of the army, with the rank and pay of colonel, died at Yonkers, N. Y., Feb. 11. He was born in Pennsylvania, Feb. 14, 1809, and graduated from West Point in 1826, as second lieutenant of engineers. He was a tutor of mathematics at the academy for a while, and from April, 1827, to August, 1829, was Assistant Professor of Military Engineering at West Point. From 1834 to 1836, he was Acting Professor of Natural and Experimental Philosophy, and then was appointed to the head of the department. From 1829 to 1834 he assisted in the construction of some of the principal coast defences, and in 1840 he was sent abroad by the government to obtain some astronomical instruments for the observatory at West Point. Professor Bartlett was the author of a number of textbooks: "Treatise on Optics," "Synthetical Mechanics," "Analytical Mechanics," and "Spherical Astronomy." He received the degree of Master of Arts from Princeton in 1837; of Doctor of Letters from Hobart College in 1847, and the same degree subsequently from Columbia College.

NEW PUBLICATIONS.

FEBRUARY MAGAZINES.—In the "Popular Science Monthly" is the first of a series of papers by Prof. C. Hanford Henderson, on glass-making in America. The paper opens with a discussion of the causes determining the location of glass-works. At the present day availability of fuel and convenience to sand or sand rock deposits are important considerations. It is a notable fact that glass-making was the first manufacturing industry started in America, a glass-works having been built at Jamestown in 1608, only a year after the establishment of the colony. Notwithstanding this early enterprise, no attempt at glass manufacture in America was a financial success until the latter part of the eighteenth century. As evidence of the importance of good and cheap fuel to glass-makers, it is stated that "so far as quantity and the perfection of processes of manipulation is concerned, the development of the glass industry has been greater since the introduction of natural gas than in all previous time."

The "North American Review" has a paper by Rear-Admiral Ammen, U. S. N., describing the proceedings of the Panama Canal Congress of 1879. The character of the Panama scheme, and the means used to further it unfairly, as compared with other projects, have been well understood in America from the first; but here the facts are recorded. Another canal paper is by Senator John T. Morgan, of Alabama, who advocates the passage of the bill granting government aid to the Nicaragua Canal. He closes his paper with the suggestion that the Pacific Railroad debt, which now amounts to about $100,000,000, should be collected by the government, and the proceeds be devoted to the Nicaragua enterprise. Gen. John Gibbon discusses "Needed Reforms in the Army." Among others, he would abolish the present system of assigning young officers to the Corps of Engineers directly upon their graduation from West Point, but would have them placed first in the Line for a tour of duty. In "The Forum" Sir Spencer Wells, formerly President of the Royal College of Surgeons, tells "how to prevent the coming of cholera." He does not take the view, which is now being somewhat widely advocated, that quarantine should be abolished and the sole reliance placed on sanitary improvement; but holds that the first duty is to raise the standard of national health, and the second is to protect the people from the seeds of infectious disease by careful inspection of all arrivals from infected ports. He also lays great stress on the

importance of cremation as a means of stamping out cholera and other zymotic diseases, and still greater stress on the importance of pure drinking water.

"The Century" has an exceedingly well written paper entitled, "Preliminary Glimpses of the Fair," and Rev. Washington Gladden continues his story of how the "Comopolis City Club" went to work to reform the administration of municipal affairs, a tale which city engineers, at least, ought to find interesting. The Secretary of the Russian Legation, at Washington, has a paper defending Russia, which may be considered as an official reply to Mr. Geo. Kennan's famous arraignment of the Russian government, as well as to the charges which have been made concerning the persecutions of the Russian Jews.

FIRST ANNUAL REPORT OF THE ENTERPRISE MINING CO., Sept. 30, 1892. With a description of the property, by Leo Von Rosenberg. New York; 4to; pp. 30; maps and illustrations.

The report of this Colorado silver mining company shows 8,906 tons of an average assay of 1.3 oz. of gold, 135.9 oz. of silver and 3.48% lead, equal to 12,005 oz. of gold, 1,210,738.6 oz. of silver and 619,890 lbs. of lead, valued at $1,000,257. The cost of mining was $23.84 per ton; total cost of production, $41.68; value, $112.31; leaving a net profit of $70.63 per ton, or $629,052. Mr. Rosenberg visited the mines last summer, and gives particulars of the geological formation and ore bodies, etc.

VARIATIONS OF LATITUDE, at Rockville, Md. Bulletin No. 25. By Mr. Edwin Smith, Assistant U. S. Coast and Geodetic Survey, Washington, D. C. Pamph., 4to. 20 pp.

This work was done in co-operation with the International Geodetic Association in the observation for variations of latitude at Waikiki, near Honolulu, and intermediate points between that place and Berlin. The station, instruments and methods of observation are described, and the full record is given. The diagram of variations in latitude observed at Rockville, between June, 1891, and July, 1892, show rather wide ranges, with an average value for the whole series of ± 0.″20 nearly. But as these variations cannot be supposed to be due to actual changes in latitude, the Government awaits the result of observations for changes now being made in San Francisco.

THEORY OF STRUCTURES AND STRENGTH OF MATERIALS. By Henry T. Bovey, M. Inst. C. E., M. Inst. M. E., etc., etc., Professor of Civil Engineering and applied mechanics, M'Gill University, Montreal. New York, John Wiley & Sons; 8vo, cloth; pp. 817; over 500 illustrations and diagrams. $7.50.

A new textbook of applied mechanics, especially that portion which treats of the design of structures, is necessarily a repetition for the most part of principles and processes already elucidated more or less clearly in several different ways. The literature on the mechanics of the design of structures is voluminous beyond that on almost any other class of engineering design, and any claim to consideration, therefore, which a new treatise has beyond others on the same subject rests largely upon the greater clearness and conciseness with which well known principles are treated. Considering how well the field is covered in these respects by the many existing textbooks on structural design, and the very few really valuable additions to the general theory from year to year, there can hardly be said to be any very great void for textbooks of statics; yet a very large proportion of the books coming before us each year are of this character. The book whose title is given above is the latest of these, and is in general much more worthy of consideration than the majority of them.

The author's reputation is a guarantee of clearness and conciseness in the treatment of the matter which must naturally be drawn from the work of others; and in addition there is a considerable amount of new matter—new, at least, in so far as its inclusion in a textbook is concerned. The most important features of this new matter are the articles on "Surface Loading," condensed from a paper read before the Physical Society, by Professor Carus-Wilson; on "Flexure of Columns," from a paper read before the Can. Soc. C. E., by Mr. Findlay; on the "Efficiency of Riveted Joints," from a paper by Professor Nicholson, published in the "Engineer," in 1888, and the author's discussion of "Maximum Shearing Forces and Binding Moments," "Flexure of Long Columns," and "Theorem of Three Moments."

The work is divided into thirteen chapters. Chapter I. treats of framed structures, beginning with the simplest frame of three members, and taking up in the order of complexity the various common types of bridge and roof trusses. Chapter II. is devoted to the general discussion of shearing forces and bending moments. Chapter III. defines and discusses the general principles of stress, elasticity, work, energy, momentum, inertia, impact, etc., etc. Chapter IV. discusses stresses and strains and their relation and application in designing retaining and reservoir walls and in earth foundations. Chapters V., VI., and VII. VIII., IX., and X., treat of friction, transverse strength of beams, pillars, torsion, and cylindrical and spherical boilers, respectively. The last three chapters take up at considerable length the common types of truss bridges, suspension bridges and arched ribs. A most valuable feature of the book is the large number (varying from 22 to 164) of typical and well selected "examples" (problems?) given at the end of each chapter. The total number of these "examples" is 804. The paper and typography is good, and the illustrations, consisting entirely of diagrams, are clear and fairly well printed. Altogether, our impressions of the work are most favorable.

TRADE PUBLICATIONS.

DUTY AND CAPACITY TESTS OF WORTHINGTON HIGH DUTY PUMPING ENGINES on Water-Works and Pipe Line Services, New York: Henry R. Worthington. 8vo, cloth, pp. 216.

In this volume the reports of 18 official tests made on the Worthington high duty pumping engine are reprinted in full, with a list of places where Worthington engines have been furnished for use on water-works service, the year when they were erected or contracted for and their daily capacity in gallons. It is surprising to note how recent is the use of the direct acting engine in water-works service. Prior to 1870 but 15 Worthington engines were installed, and their total capacity was only 37,500,000 gallons. During the '70's the annual output averaged about a dozen engines with a combined capacity of some 38,000,000 gallons. In 1879 began a steady increase, which has continued until in 1891 the total output was 100 engines with a total capacity of 343,000,000 gallons, or well nigh as great a production as the total for the ten years prior to 1880.

The Worthington engines supplied to foreign countries formed a considerable part of the total output, and not a few of them were of the triple expansion pattern. So far only two Worthington triple expansion engines are in use in this country. One of these is at Port Perry, Pa., and the other was built for the World's Columbian Exposition.

It is a pity that in compiling the book a summary was not added to show the principal results of the several tests in one table. Such a summary would be most convenient for reference.

SOCIETY PROCEEDINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the students' meeting on Feb. 10, a paper on "The Disposal of Sewage at Marlborough, Mass.," was read by Mr. J. M. McPhail.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.—This club, of Louisville, Ky., has elected the following officers for the ensuing year: President, Marshall Morris; Vice-President, H. P. McDonald; Secretary, F. W. Mowbray.

WESTERN RAILWAY CLUB.—The next meeting of the Western Railway Club will be held in the Rookery building, Chicago, Feb. 21. The paper of Mr. G. W. Rhodes, on "Wheel Flanges," read at the January meeting, will be discussed; and Mr. William Forsyth, Mechanical Engineer of the Chicago, Burlington & Quincy R. R., will read a paper on "Tests of Locomotives in Heavy Express Passenger Service."

BOSTON SOCIETY OF CIVIL ENGINEERS.—A regular meeting was held Jan. 25, Henry Manley, President, in the chair, and about 50 members and visitors present. Mr. Edward B. Adams read a paper on the "Lighthouse System of the United States," covering in a very comprehensive manner the history and theory of lighting our coast, and the present organization of the system. The paper was illustrated by drawings and photographs of the various forms of lighthouses, beacons, buoys, sirens, etc., and it was followed by a short discussion. S. E. Tinkham, Secy.

NEW ENGLAND WATER-WORKS ASSOCIATION.—An adjourned meeting of the association was held at Boston on Feb. 8, at which Mr. Freeman C. Coffin, C. E., of Boston, read an interesting and valuable paper on "Stand-Pipes and their Design," which will be noticed at length in a later issue. Mr. A. Prescott Folwell, C. E., of Orange, N. J., described the new water-works of Atlanta Highlands, N. J., including a double standpipe for the low and high service systems. Before the meeting an excusion was made, at the invitation of Mr. F. S. Pearson, Chief Engineer, to the power station of the West End Street Railway Co.

The following members were elected: Resident active, John MacNair and D. A. Sutherland, Lynn, Mass.; Geo. C. Whipple, Chelsea, Mass.; John T. Cavanagh and H. T. Whitman, Quincy, Mass.; Prof. L. P. Kinnicutt, Worcester, Mass.; Jas. H. Higgins, Providence, R. I.; Chas. H. Bartlett, C. E., Manchester, N. H.; R. H. Tingley, C. E., Pawtucket, R. I.; E. W. Kent, C. E., Woonsocket, R. I. Non-resident active, John A. Berkley, St. Paul, Minn.

OHIO INSTITUTE OF MINING ENGINEERS.—The annual meeting was held at Columbus, O., recently, and the following papers were read: "The Cambridge Coal Fields," William H. Turner, Cambridge; "A Standard Grade of Power Necessary for Mines," James W. Haughn: "Fire Clay Industry in the Hocking Valley," John E. Short; "A Practical System of Mining Coal in Ohio," Thomas A. Love; "Explosives," Capt. J. L. Morris; "Mine Surveying," William Hibbs; "Tests of Ohio Building Stone," C. M. Brown, Ohio State University; "Miners' Sunshine and Its Uses," Wm. B. Rennie, and "Sewerage, Drainage and Water Supply," Prof. F. W. Sperr, Ohio State University.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—The next meeting will take place at the Kimball House, Atlanta, Ga., April 20, 1893, at 10 o'clock a. m. The subjects for discussion will be as follows: "Air Brake Practice; Piston Travel in Inches, and Determination of the Actual and Available Brake-Power," W. J. Hartman, J. M. Holt and R. E. Libby; "What Are the Best Devices and Appliances in Draft Rigging and Draw-Bars to Prevent Damages and Wrecks, and Reduce Maintenance of Those Parts," R. D. Wade, C. B. Gifford and F. H. McGee; "Soft Plugs for Crown-Sheets of Fire-Boxes; Best Form and How to Keep Them Effective," Philip Wallis, T. W. Gentry, W. Hassman and W. T. Hooker. The committee on "Staybolts Inspection," R. P. C. Sanderson, chairman, is expected to make a report. S. A. Charpiot, Secy.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—The regular monthly meeting was held Feb. 6, 16 members and 6 visitors in attendance. It was unanimously resolved that the U. S. Senator and Representatives in Congress for Minnesota, also the chairmen of committees to which has been referred the bill appropriating $40,000 for the continuance of the United States timber tests by the Forestry Division of the Agricultural Department, be advised by the president and secretary of this society of the far-reaching benefits to the public and to the engineering profession which, in the judgment of this society, the passage of this bill would procure.

A paper on "Railway Building in Mexico" was read by Mr. W. H. Wood. At present nine-tenths of Mexican imports enter via Vera Cruz. This port has no docks, and all traffic must be pieced out by lighters. The recent harbor improvements at Tampico and the proposed direct line of railway to that port from the city of Mexico will probably divert much traffic to the new route. Deep water, docks, climate, railway grades and facilities will all be in favor of Tampico. Mr. Chas. Steiner read the paper on the utilization of the Minnehaha water power previously presented before the Minneapolis Engineers' Club. C. L. Annan, Secy.

COMING TECHNICAL MEETINGS.

WESTERN RAILWAY CLUB.
Feb. 21. Secy., C. F. Street, Rookery Building, Chicago.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 21. Secy., E. H. Clark, Pittsburg.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 21, etc. Annual meeting, Montreal, Que. Secy., R. W. Raymond, 6 Burling Slip, New York, N. Y.
ENGINEERS' CLUB OF ST. LOUIS.
Feb. 22. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 22. Secy., F. Collingwood, 127 East 23d St., New York.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 22. Annual meeting. Secy., J. R. Schiek, Roanoke, Va.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 24. Secy., C. H. McLeod, Montreal, P. Q.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 28. Secy., F. E. King, Jacobson Block.
WESTERN SOCIETY OF ENGINEERS.
March 1. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago
ENGINEERS' CLUB OF MINNEAPOLIS.
March 2. Secy., E. Nelson, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 3. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 3. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
March 4. 1122 Girard St. Secy., L. F. Rondinella.
MONTANA SOCIETY OF CIVIL ENGINEERS.
March 4. Secy., F. D. Jones, Helena.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 6. Secy., C. L. Annan, City Engineer's Office.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 7. Secy., Chas. S. Howe, Case School.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
March 7. Secy., W. Halliburton.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
March 8. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
March 8. Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
March 9. Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
March 9. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 10. Secy., D. W. Meeker, St. Paul.
WISCONSIN POLYTECHNIC SOCIETY.
March 13. Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
March 13. Secy., Waterman Stone, Baird Building.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
March 14. S. W. Spear, E. Buffalo, N. Y., Iron Works.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 14. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
NORTHWEST RAILROAD CLUB.
March 14. Union Station, St. Paul. Secy., W. D. Crosman.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 15. Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
March 16. Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
March 16. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
March 16. Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
March 17. 201 Washington Building.
SWEDISH ENGINEERS' CLUB.
March 18. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
CENTRAL RAILWAY CLUB.
March 22. Secy., S. W. Spear, Buffalo, N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB,
April 20. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXIX. THURSDAY, FEBRUARY 16, 1893.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

Chicago Office: Monadnock Building.
F. A. PECKHAM .....MANAGER

EUROPEAN AGENCIES:
KEGAN PAUL, TRENCH, TRUBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & Co (Limited). St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: One year, $5.00; 6 months, $2.50; 4 months, $2.00; single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon: new advertisements, Tuesday afternoon; transient advertisements not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

We begin this week a somewhat novel feature of this journal, and one which we hope will prove both interesting and valuable, viz., the presentation from time to time of "Industrial Supplements," the first one of which, on "Bonanzas in Clay," will be found among our advertising pages, and will explain the scope and purpose of these supplements better than we can do in words.

The Panama Canal trial has ended as it should, if justice was to be done according to the evidence, in sentences of five years imprisonment against both Ferdinand de Lesseps and his son Charles, and in sentences of two years' imprisonment against Gustave Eiffel and MM. Fontane and Cottu. Technically the first two named were the most guilty, because their misdoings extended over a longer period and a greater variety of crime. Morally, however, Eiffel is the most guilty and Ferdinand de Lesseps the least guilty of them all, and we hope, and cannot doubt, that executive mercy will intervene between the elder Lesseps and any attempt to execute the sentence. He has deserved well of France and of the world for past achievements. He is an old man, in his 88th year, and so feeble that he knows nothing of current events. The actuating motive for his misdoing has beyond doubt not been personal gain, but chiefly, if not solely, to win for himself and France the glory and legitimate profit of carrying through another great work, for which he justly thought that his own past achievements would enable him to do much. He was not an engineer, and has nothing of the training of an engineer to enable him duly to weigh the technical objections to his plans at Panama; while he had acquired at Suez a contempt for engineers' opinions, from seeing how they could be based upon scant grounds and be used for mere purposes of obstruction. Nor should he be blamed too severely if he deliberately neglected to ascertain in advance what the work was likely to cost, from a feeling that it would pay liberally whatever it cost, and that to state too large a sum in advance might only serve to frighten off timid investors, to their own injury and the world's. We are not defending such a course. The event has shown how terribly mistaken a policy it was. We only say that when done for pure motives and personal conviction, it does not degrade the man morally, as does any form of intentional swindling. As to the later forms of corruption, we dare say that a good deal of the same kind of work was done to carry through the Suez Canal, but success never brought the facts to light. Infamous as they would have been in the beginning, we can understand how they might have been tolerated or even initiated by Lesseps from pure motives, standing as he then did in the position of trustee for past investors. The old man should have the benefit of the doubt. Some fragment of his great fame, at least, should be left to him.

Nothing of this can be said for Eiffel. His acts were of the lowest and meanest criminality, even if committed by a poor man. Committed as they were by a man rich in fame and fortune, after he had been resorted to by his only peer in France to aid in extricating him from a peril which seriously involved the good name of France as well, it is difficult to conceive of conduct more base than his. According to the statements of the judgment, M. Eiffel received in all $24,000,000 (120,000,000 fr.), out of which great sum he expended in all only $244,600 for material. What would have been the result had M. Eiffel, instead of stealing all this money, exerted himself to make it go as far as was possible toward completing the locks, waiting for his own profit until the completion of the works, if he got any? It would probably have finished the locks: it might easily have changed the whole result of the enterprise; for the canal with locks was not an impossible enterprise, as was the sea-level canal; and with the locks built in a good and workmanlike manner and ready for work, some way would doubtless have been found to have finished the rest of the work, by sufficient sacrifices on the part of the older investors. It may truly be said, at any rate, that the ridiculous fiasco of the lock work, combined with its enormous cost, gave the final coup de grace to the company, whether good work on the docks would have saved it or not. M. Eiffel, therefore, deserves a much more severe sentence than what he has received, which was the utmost the law permitted, and he will doubtless have to serve his sentence. As for Charles de Lesseps, he also deserves little sympathy. Without his father's excuse he went far beyond him in corruption, and there can be little doubt that a part of his corrupt conduct was to feather carefully his own nest.

We reported in our issue of Jan. 26 the important announcement by the Forestry Division of the Department of Agriculture that the timber of long leaf pine is in no way injured by the process of tapping for turpentine, and a fuller statement of the test experiments which were made in investigating this matter has been issued by the Forestry Division, and is reprinted in substance in another column. The importance of this decision from a practical point of view is perhaps not as great as at first might appear; for it is claimed that notwithstanding the general discrimination against bled timber in carefully-drawn specifications, the engineers and architects who have insisted on this requirement have actually been furnished with timber as it came from the forest, bled and unbled, mixed together, and have never known the difference. To quote from the paper by Mr. Richard Lamb, published in our issues of Nov. 30 and Dec. 7, 1889: "The standard specification for pine lumber is 'best, all heart, untapped Georgia pine.' But it is an exceedingly rare occurrence that a delivery is made of untapped long leaf pine."

The assumption (and it seems to be nothing more) that the timber was injured by tapping was a natural one; but it ought not to have stood as long as it has without investigation to determine its truth. Considerable light was thrown on the question by the paper of Mr. Lamb above referred to; and a preliminary report of the Forestry Division, abstracted in our issue of April 2, 1892, indicated that the injury to the timber by tapping, if it existed, was only a decrease in durability. The final tests, however, have proved that the discrimination against bled timber is wholly useless. Critics may well ask how many more of the standard requirements of engineers' specifications are based on similar flimsy grounds? It must be said, in fairness, however, that timber has been so little used of late years in structures of importance that engineers have paid comparatively little attention to it. The specifications now in vogue for iron and steel, while open to criticism in many respects, contain, we believe, no requirement so universally accepted and at the same time so wholly baseless as this discrimination against bled timber.

"The Position of Aluminum" is discussed most unfairly and misleadingly, it seems to us, in a recent number of the "Engineering and Mining Journal." The editor says that at the present time the production of that metal is but little beyond the experimental stage, and may be compared to the manufacture of iron in the days of Tubal Cain. He takes the ground that at the present price of 50 cts. per lb. aluminum is too dear for any extensive use, and that it cannot be produced by electrical methods at a sufficiently low cost to make it a prominent metal in the arts. He therefore urges further experimenting with a view to aluminum production by other means than electrolysis, and the general purport of his article is to encourage and delude with false hopes those who are striving after some process of extracting aluminum from clay or some cheaper method of producing the metal than the present electrolytic.

The basis of our contemporary's argument seems to be that the present market price of 50 cts. per lb. is well toward the minimum at which metal produced by electrolysis can be sold. But as we have repeatedly pointed out, this is far from being the case. In our issue of March 7, 1891, Mr. Alfred E. Hunt, President of the Pittsburg Reduction Co., gave the following statement of the theoretical cost of producing one pound of aluminum by the Hall process:

2 lbs. alumina (containing 52.94% aluminum) at 3 cts.	$.06
1 lb. carbon electrode at 2 cts.	.02
Chemicals, carbon, dust and pots.	.01
22 E. HP. exerted one hour (water power being used).	.05
Labor and superintendence	.03
General expenses, interest and repairs	.03
Total.	$.20

Mr. Hunt then proceeded to analyze the possibilities of other processes being able to compete with the electrolytic, and showed conclusively that while such possibilities existed, the probabilities in their favor were very small. By all means let any one who doubts this conclusion experiment as much as he likes, but if any of our readers propose to spend time or money on rival methods of aluminum production they should first study the possibilities of the electrolytic process and see what competition they must meet. It is to be noted, moreover, that the figures given above by no means represent the minimum possible cost by the electrolytic process. The cost of power may be considerably reduced, perhaps even halved, by the use of cheap water powers now undeveloped and valueless. If another process can use a cheaper ore, it is quite probable that the electrolytic process can; and the charge for labor, superintendence, general expenses, interest and repairs should be capable of considerable reduction in a plant working on an enormous scale. Taking all these things into consideration, anyone proposing to compete with the electrical process will do well to reckon on not over 15 cts. per pound as a probable future price to be made by manufacturers working under the electrical process, provided they are forced to it by competition. Bearing this in mind, the value of processes proposing to compete with the electrical can be investigated with some degree of accuracy.

Concerning the second plea of our contemporary, that aluminum is still too expensive to be of much importance in the arts, the fact should not be overlooked that the low specific gravity of the metal makes the price per pound a really misleading index of its actual cost. In almost every use of metals, the amount necessary for a given purpose is measured by volume and not by weight. So many square feet of roofing of a given thickness are wanted, a tube must be made of a certain diameter and thickness, etc. Thus bulk and not weight is the real measure by which the cost of aluminum must be determined, to a very large extent. Even at the present high price of 50 cts. per pound, therefore, aluminum is as cheap as copper at 14 cts. or tin at 18 cts. Copper is now selling at about 12 cts. and tin at about 20 cts. per pound., and hence it can be fairly said that aluminum is even now able to compete with these metals on an approximately equal basis for many uses. As we have seen above, it is probable that the electrolytic metal will yet be put on the market at 20 cts. per lb. or less. It will then, doubtless, supplant copper in many fields where that metal is now the sole reliance, and will compete for many purposes with such cheap metals as tin and zinc.

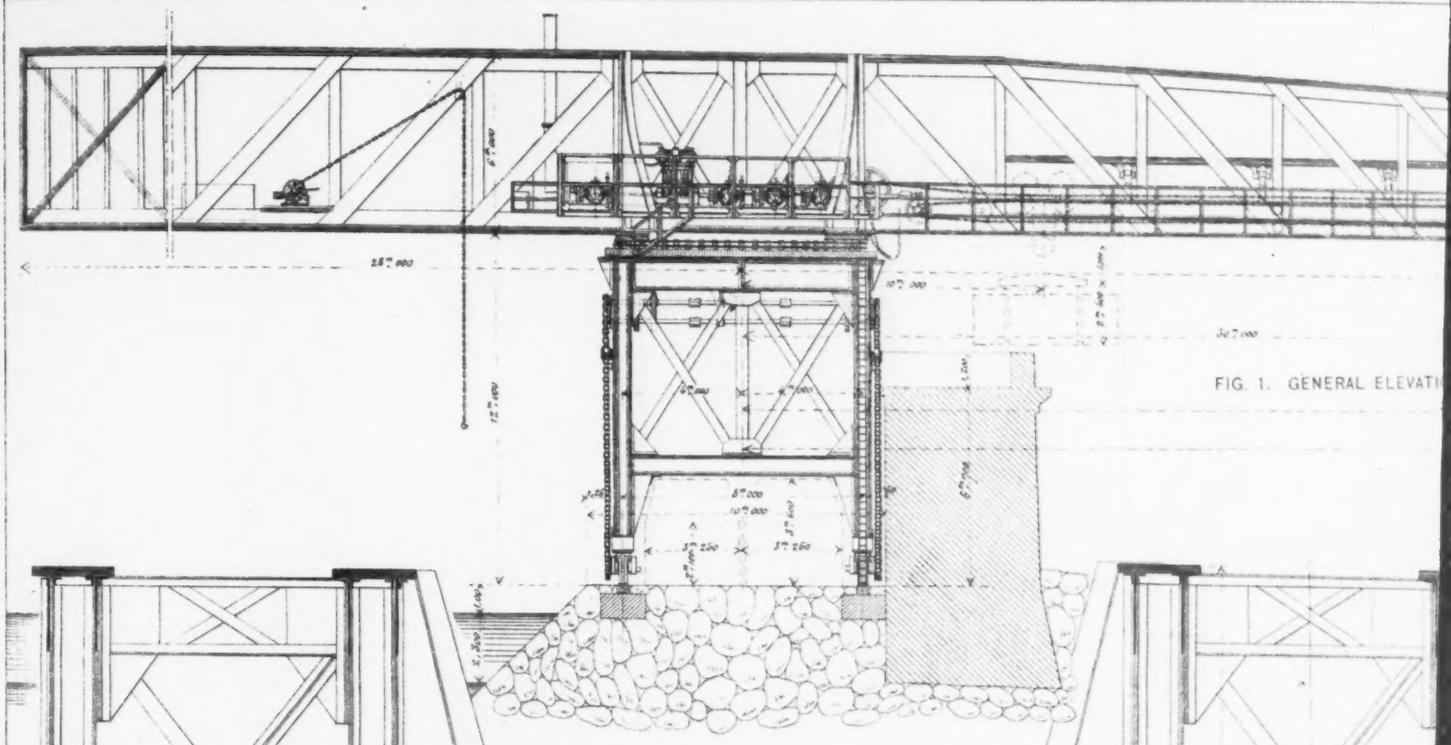


FIG. 1. GENERAL ELEVATI

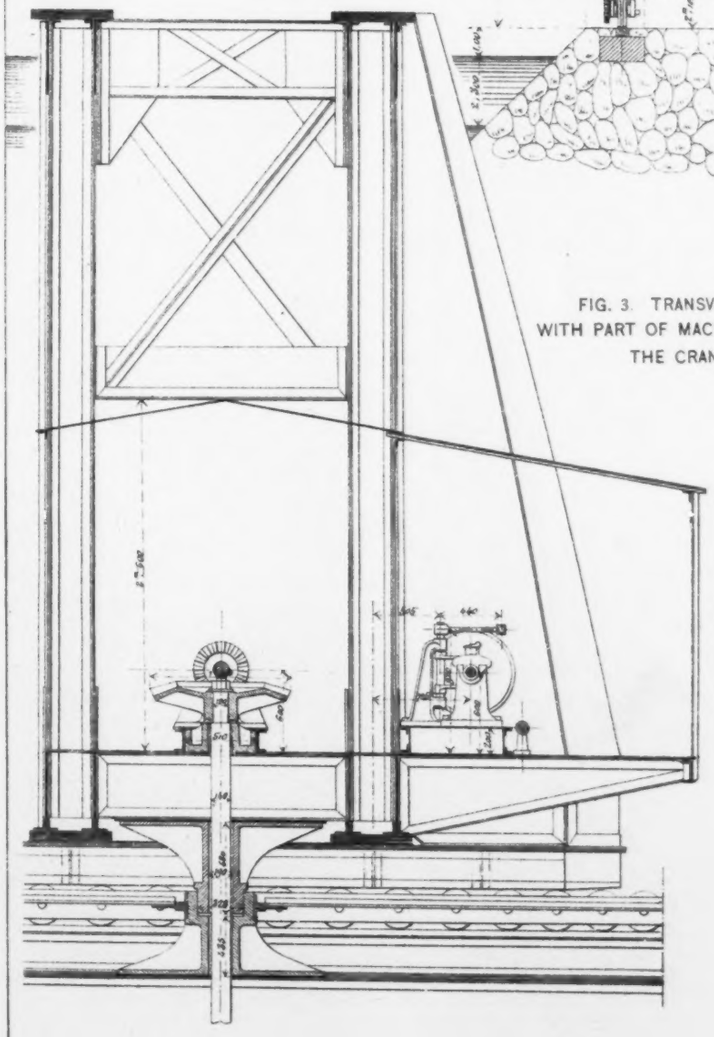


FIG. 3. TRANSVERSE SECTION, WITH PART OF MACHINERY FOR MOVING THE CRANE-TOWER.

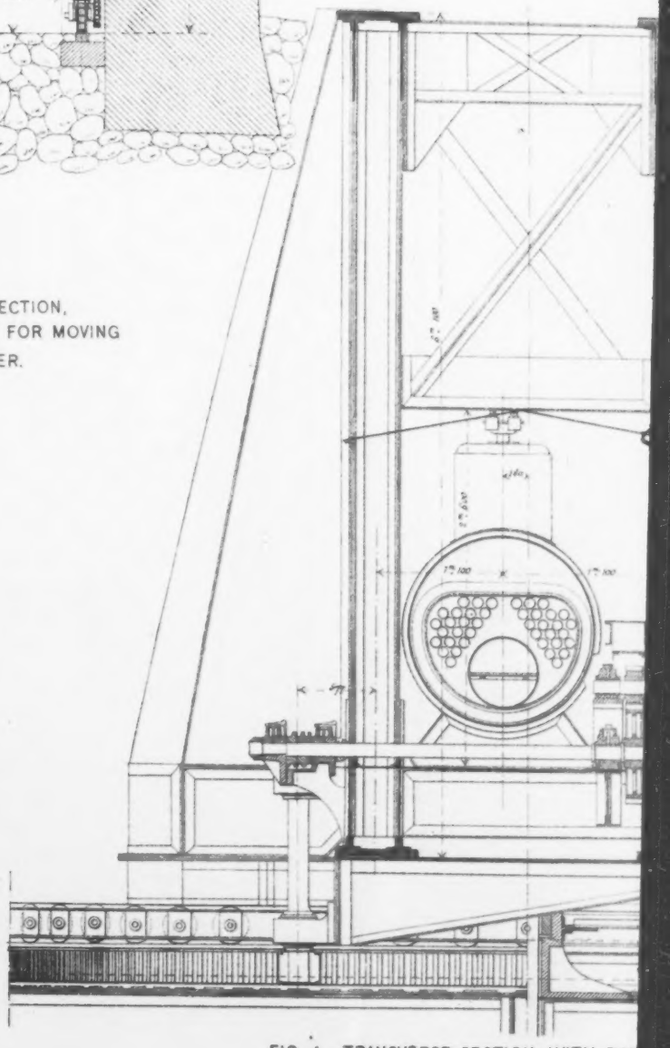


FIG. 4. TRANSVERSE SECTION, WITH PIV

THE 35-TON CRANE AT PUNTA-DELGADA, AZORE

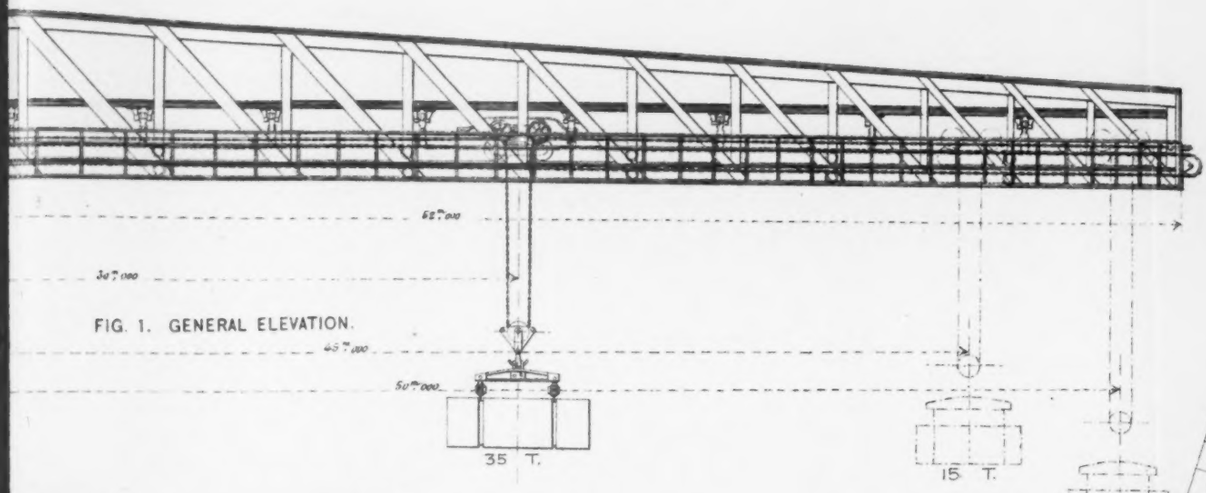
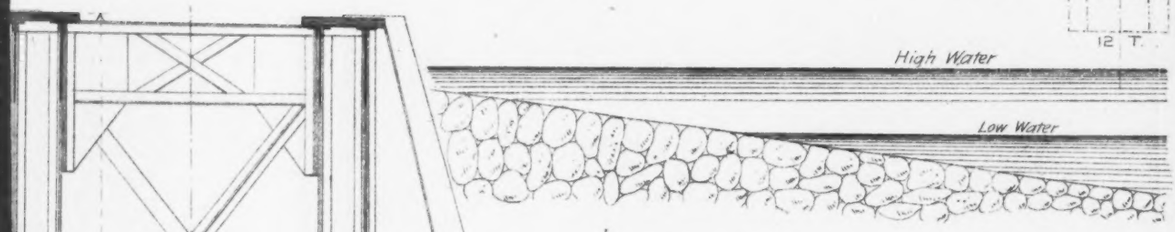
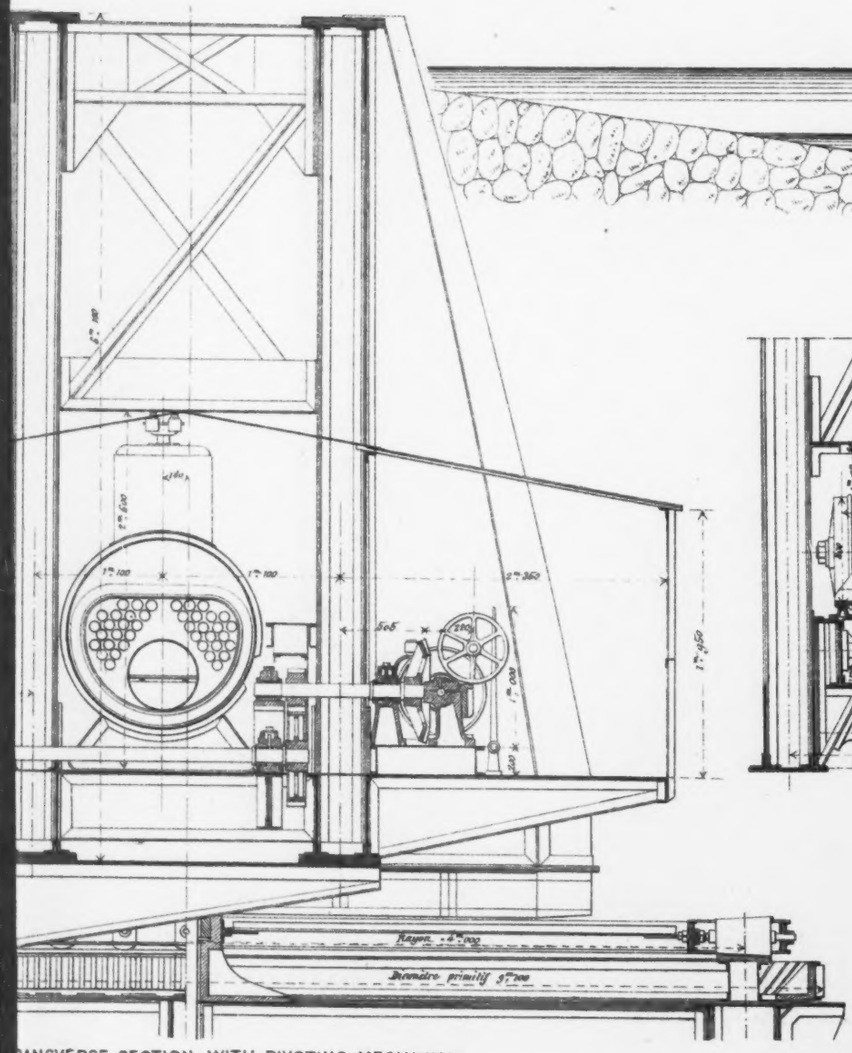


FIG. 1. GENERAL ELEVATION.





RANSVERSE SECTION, WITH PIVOTING MECHANISM.

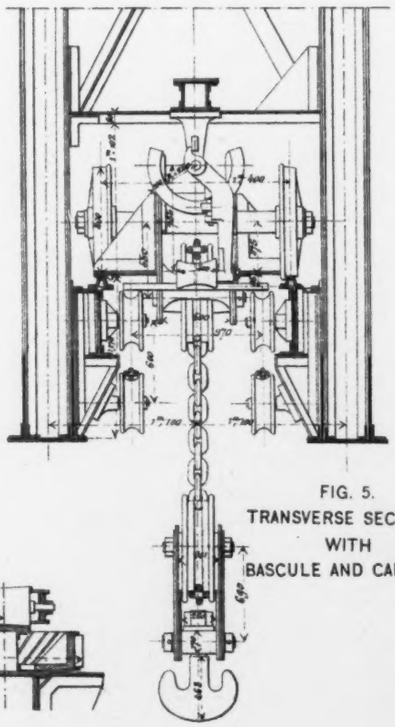


FIG. 5.
TRANSVERSE SECTION,
WITH
BASCULE AND CARRIAGE.

FIG.

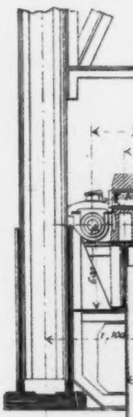


FIG. 6. SECTION

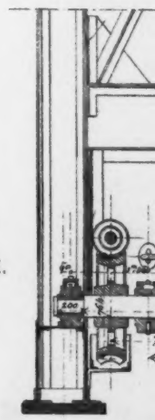


FIG. 7. SECTI
MECHANISM

NTA-DELGADA, AZORE ISLANDS. T. Seyrig, Constructing Engineer.

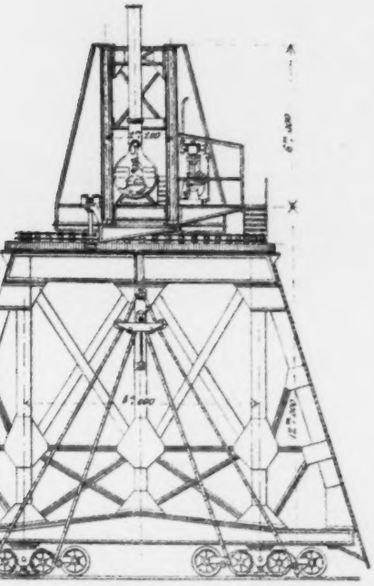
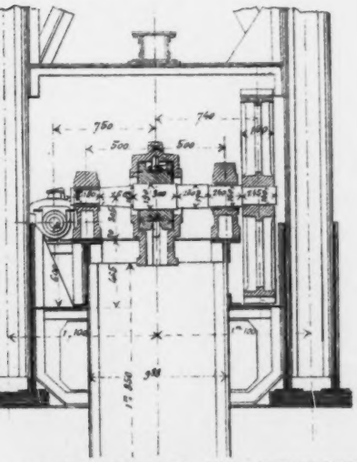
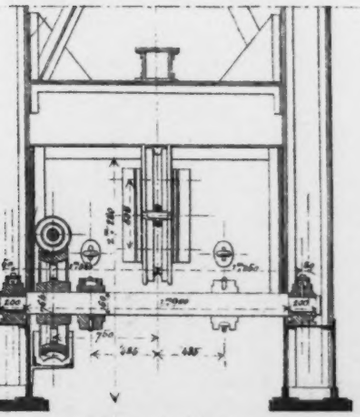


FIG. 2. SIDE VIEW.



6. SECTION OF WING, AND LIFTING WINCH.



. 7. SECTION OF WING AND PART OF
MECHANISM FOR MOVING CARRIAGE.

CHAS. HART & SONS, LITH, 36 VESEY ST., N. Y.

LETTING HIGHWAY BRIDGE CONTRACTS.

We give space this week to several interesting letters discussing further the evils of the present system of letting highway bridge contracts. Both the engineer and the bridge builder are represented in the discussion, for it must be admitted that the two parties look at the question from quite different standpoints. At the same time they are by no means diametrically opposed to each other; and although, as one correspondent says, the bridge builders have used their influence in the past to defeat measures of reform which were urged by engineers, we believe that any plan which promises real improvement over the present condition of the bridge business would be welcomed by engineers and bridge builders alike. It is largely with the hope of uniting the two parties in the furtherance of better methods that we continue the discussion.

In the first place, there seems reason to believe that engineers, as a class, are rather unjust to the work which is erected by reputable highway bridge builders at the present time. The tenor of recent discussions before engineering societies has been that without an engineer to examine the plans and inspect the work, there was no assurance that the contractor would put up a good and safe structure. It is not strange that this impression should exist, for there are undoubtedly very many iron highway bridges now standing of which it is difficult to say anything bad enough. But the question is not concerning the bridges of a score, or ten, or even five years ago, when iron and steel and shop work were far more costly than now, but is as to the bridges now being erected and those which are to be erected in future years. At the present time, with the beams, channels, angles and plates of which bridge members are built up selling in the open market at an average of less than 2 cts. per lb., there is so little to be gained by paring down sections that the bridge company which does it pursues a penny-wise and pound-foolish policy. The few hundred-weight of iron which makes the difference between a reasonably safe bridge and a dangerous one makes so little difference in its actual cost, that purely as a matter of policy a reputable bridge company cannot afford to cut down weights very greatly, at least on any structure of moderate size.

The reason is, of course, that a bridge company which has any reputation to lose can have no worse evil befall it than to have one of its structures fail. The commissioners who are intrusted with the letting of bridges may not know a bolt from a rivet, or a truss from a floor beam, but every one of them, and the public behind them, can fully comprehend the fact that such and such a company's bridge fell at such and such a place, and the competing companies will take care that the fact is fully advertised and "worked" for all it is worth.

We do not overlook the fact that at present low prices for material, it would be real economy to build much heavier and stiffer structures for highway bridges than are ordinarily put up, and to follow the example of the railways in substituting plate girders and riveted trusses for the old pony and pin-connected trusses. But it can hardly be said that this reform is demanded on the score of safety. If the engineer can persuade his clients that solid and monumental structures are the cheapest in the long run, well and good. But it is quite out of the question to expect that either engineers or bridge builders can bring about any general reform of this sort except by slow degrees.

In thus defending reputable bridge builders from the charge that at the present time they are erecting seriously weak or defective structures, we do not forget that monstrosities and shams still exist in the bridge business. We showed one, of the "self-anchoring suspension" type, two weeks ago, and a correspondent this week instances another. But do dangerous rattle traps of this sort form any large proportion of the bridges at present erected? Is not the "patent bridge" agent gradually disappearing from the field, and do not the agents of the reputable bridge companies generally unite to defeat the slim chances of irresponsible and dishonest bidders of this class? We understand this to be the case, and if we are wrong, are open to correction.

The important fact that needs to be emphasized, however, is that whether the success of these vendors of "quack" bridges be great or small, the only thing which gives them any showing in the field is the abnormal cost of good bridges built by honest firms, due to the causes which we detailed in our issue of Jan. 19. If iron highway bridges were generally sold at the actual cost of making and erecting, plus a fair profit to the manufacturer and a reasonable sum only to cover the cost of sales, the vendors of the patent bridges and the cheap makeshifts would find their occupation gone. The difference between their work and that of reputable bridge companies is so great that even the non-technical man can discern it, and they could no longer hold out the tempting bait of "a bridge at half the cost of the common type."

The second point on which engineers and bridge builders must be in better harmony before they can work together to reform highway bridge practice concerns the design of bridges. Our correspondent "W" reports an interesting experience in bidding on a bridge for which plans were prepared by an "engineer"; and his argument deserves careful consideration. If a bridge of exceptionally long span, or one involving some peculiar problems of design is to be built, there may be a valid argument in favor of having the engineer prepare detailed plans for the structure and receiving bids upon them. But in the case of the ordinary highway bridge of moderate span, to require bidders to estimate on detailed plans will, in nine cases out of ten, considerably increase the cost of the bridge, exactly as our correspondent describes, and that without securing any better structure. Why this is so is easily seen. Every bridge shop has, more or less, its own methods and details, which it can follow much more cheaply than it can vary from them. So far as these differences of practice do not affect the strength or security of the structure, there is no reason for the engineer to interfere with them, and the result of his doing so will be increased cost to his clients. Again, the preparation of estimates and bids can be done by the bridge company's engineers on their own standard designs much more quickly, cheaply and closely than bids can be prepared on the basis of the detailed plans prepared by the average engineer. Few, very few, of the engineers generally employed by county commissioners are as competent to design an ordinary bridge in such a manner as to get the best result for the least money as are the engineers employed by the bridge companies; and it is not to be expected that any engineer having a general consulting practice should be as well posted concerning shop practice as the engineer who works at bridge designing and dimensioning six days in the week.

Granting then that those who let highway bridge contracts do not need an engineer to design their bridge, and are reasonably likely to get a safe structure in any event, the chief reason which remains for employing an engineer is to reduce the cost of the bridge, or rather the present wide margin between the cost to the builder and the cost to the buyer.

In our former article we had no expectation of doing more than hinting how an engineer employed to supervise the letting of a contract might proceed to obtain for his clients a good bridge for the least money, viz., by furnishing prospective bidders such full information that they could know exactly what was required, and then forbidding the presence of the agent of any bridge company at or prior to the letting.

We suggested also the plan of restricting the number of bidders to three or four selected firms, but this plan, while often the wisest and best course for all parties concerned, where a private firm or a corporation is letting a contract, is probably out of the question in letting municipal or county work. The opportunity which it would open for corruption and favoritism is sufficient to condemn it, for any general adoption at least.

There remains to be considered, then, only the single plan of requiring mailed bids and excluding bridge agents. By this simple change the present opportunities for bribery, as well as the incentives to the formation of pools would be practically abolished. The pooling system seems destined to break down by its own weight, for it brings to each letting the representatives of many companies who come with no expectation of getting the contract, but simply to get their share of the pool. On the other hand the proposed change would not necessarily result in fewer bidders, for the cost of preparing and mailing bids is so little compared with the cost of having a representative on the ground that more bridge builders would think it worth while to take part in the competition.

Notwithstanding the increase in the number of bona-fide bids and the reduced cost to the purchaser, it by no means follows that the bridge company's average profits would be reduced. At present, when agents bid in a "straight fight," they have strong motives to bid very low, in order to get some return for the cash and time spent in attending the letting; but the company sending a mailed bid, unless it is in great straits for work, will not submit a price which will not leave some profit.

Much more might be said concerning the advantages which would result from the proposed change, could it be brought about; but the question is, Can it be? There seem to be no especial obstacles to hinder a city engineer or an engineer called to supervise a bridge letting from requiring mailed bids, but that is quite a different thing from so educating the public that it shall be common practice to call in an engineer's services when a bridge, large or small, is to be built.

One of our correspondents this week outlines a proposed system for "educating the public" on this matter. Without criticising his proposals in detail, it seems to us that the support of the bridge builders is a necessity to any rapid reforms in this matter. The agents of the bridge companies have far more influence and wider personal acquaintance with the buyers of bridges than do the engineers; and if this is to be exerted against the reform, it must make slow progress.

But are not the bridge companies dissatisfied with the present system of doing business, which, as we have said before, has been practically forced upon them? Would they not prefer to mail a bid on brief and clear specifications prepared by a competent and honest engineer than to join in the present strife for official favors, with the satisfaction when they get a contract of having to divide a good share of its proceeds in pools? If this is the case, we see no reason why they may not join with engineers in promoting a better condition of affairs.

AN ENGLISH VIEW OF AMERICAN RAILWAYS AND LOCOMOTIVES.

The comparison of the merits and efficiency of American and English locomotives is a matter of continual discussion in English papers, and we have occasionally taken part in the discussion, generally to point out defects and errors in the arguments against the American engine. As we have often stated, we do not intend to follow up the controversy at length, for the reason that it has so little practical interest on this side of the Atlantic, but we give this week a communication received from an engineer in England, which contains some interesting information, some misinformation, and some arguments based upon entirely erroneous assumptions, being a good example of the average English criticism upon American railways. It is to be regretted that the discussion is taken up extensively by men who are apparently unfamiliar with more than one side of the question, and who are, therefore, entirely unqualified to make comparisons and draw deductions therefrom and to pass judgment on either side. Our correspondent, who is apparently not a very careful reader of this journal refers to an undesirable spirit which he thinks marks much of American criticism of foreign practice, and also refers to unfair comparisons of the weights of American way trains with English express trains, but makes no reference to the very prejudiced character of English criticism of American practice, and is himself guilty of most unfair and useless comparison of a light American train with a heavy English train, an error he might easily have avoided by making a little inquiry before making his criticism on a false basis. It will be seen by the letter that he is apparently as unfamiliar with American railway track as with American trains. A few words will show the specific errors of our correspondent, and for a general comparison of English and American practice we refer our readers to our issue of July 4, 1891, while in various later issues we have given particulars of English railway practice and equipment, etc.

The proportion of slow passenger trains in England is very much underestimated by our correspondent, and such trains are certainly not confined to short branch lines, while main line trains are by no means invariably fast and frequent. In our issue of Jan. 12 we showed that ordinary English fast trains are by no means as heavy as ordinary American fast trains, and our correspondent is arguing on an entirely wrong basis when he speaks of the light, four-car express on the Philadelphia & Reading R. R. as a maximum train load for an eight-wheel engine. The fast run with that train was made with a view to ascertaining what rate of speed could be obtained, and without any attempt to run a very heavy train, still less to typify American practice. The engine could probably have hauled as heavy a train as the English train at as high speed as the latter, instead of hauling a lighter train faster, but it is useless to compare the work done by the engines of these trains, since the trains are not comparable, the American train certainly not representing anything like the "maximum duty" of its engine.

The heaviest express train on the New York Central & Hudson River R. R. is No. 5, the Fast Western Express, leaving the Grand Central Station, New York, every day at 6 p. m., and averaging as many as 13 cars. We are indebted to Mr. William Buchanan, Superintendent of Rolling Power and Motive Stock, for particulars of the weight and speed of this train. With twelve cars the train is made up as follows:

	Lbs.
1 drawing-room car	75,000
1 dining car	88,000
7 sleeping cars (85,000 lbs., 86,000 lbs., 94,800 lbs., 95,000 lbs., and three of 90,000 lbs.)	631,100
2 coaches (60,200 lbs. and 49,000 lbs.)	109,200
1 baggage car	47,500
Total	950,800

This represents a train load of 475.4 net tons (424.4 gross tons of 2,240 lbs.) behind the tender, exclusive of weight of passengers and baggage. The engine and tender weigh about 100 net tons. The speed is about 40 miles per hour, but sometimes averages 55 or 60 miles per hour, which, considering the weight of the train, is something remarkable. On Oct. 19, 1892, the Southwestern Limited Express (eastbound), No. 18, left Syracuse, N. Y., 43 minutes late (11:23, instead of 10:40 a. m.), and after one stop at Utica arrived at Albany at 2:10 p. m., on time, having made the 147½ miles in 2 hours 47 minutes, or at the average rate of nearly 53 miles per hour for the entire distance. This train weighed 359.5 net tons (or 321 gross tons of 2,240 lbs.) behind the tender, and was made up as follows:

	Lbs.
5 sleeping cars	475,000
2 coaches	164,000
1 combination car	80,000
8 total	719,000

As to track, it is time that Englishmen escaped from some of their illusions, based on the conditions of some decades ago, for things change a great deal in this country, even in a single decade. Thousands of miles of our leading roads have track equal to the best English track, yet our correspondent is apparently still in the same box with an eminent English railway engineer who stated in correspondence a few years ago that American track, being merely similar to "contractor's track," would not stand for an hour under the heavy and fast trains on his road. When, however, he was given drawings of track with rails of 80 to 100 lbs. per yd., steel tie-plates, and stone ballast, and particulars of engines and trains heavier than those of his road, he frankly admitted that he had had a wrong idea of American track and had written without proper knowledge of his subject. It will suffice to state here that the Philadelphia & Reading R. R. and New York Central R. R. express trains, instanced above, ran over 80 and 90-lb. rails, with roadbeds well ballasted with broken stone, and to note also that the great defect of English track is in its wooden keys, as pointed out in our articles on English railways in the first volume for 1891. Various devices are used to keep these keys in position in the chairs, with more or less satisfactory results, and metal keys are used to some extent, but loose wooden keys are to be seen on the best tracks.

In regard to the rolling stock, six-wheel trucks are very much more common in this country than in England, and while many roads in England are putting more and more of their cars upon trucks, only a few, including the Midland and the Lancashire & Yorkshire (Eng. News, March 28 and May 9, 1891) are using six-wheel trucks. Besides this, steel-tired paper wheels 42 ins. diameter are by no means so uncommon on our modern American passenger equipment as the letter implies. Moreover, though the chilled wheel is passing out of use for passenger service, it is a vastly better wheel than our correspondent has any idea of, and nothing but ignorance and prejudice, not sound judgment, keeps the English from using it in freight service. American cars built for an English railway were illustrated in our issue of Oct. 10, 1891. Surely our correspondent does not refer to a six-wheel English car with three rigid axles and about 24 ft. rigid wheelbase as a "six-wheel truck." As to the tenders, English practice, with three rigid axles, would hardly be as suitable for sharp curves as American practice with two four-wheel trucks, while the latter are much easier on the track. The tenders of the Reading engines are by no means little, but as track tanks are used on the line between Philadelphia and New York, the tender tanks may be smaller than for engines running where track tanks are not used. This is, we understand, the reason for the large tender of the Northeastern Ry.

We have referred more than once to the advantages of large driving wheels for express engines, and to the growing tendency to the use of such wheels for express engines in this country, but have also shown that the use of single driving wheels does not appear probable or necessary, as the coupled engines have made excellent speed records and can handle very heavy loads (Eng. News, July 21 and Dec. 8, 1892). An advantage of the coupled engines is that they can handle very varying loads and under severe conditions. On the other hand, not all English roads use engines with single driving wheels of 7 ft. 7¼ ins. diameter, to any great extent, but eight-wheel engines with four-coupled driving wheels, 6 ft. 6 ins. diameter, and a four-wheeled leading truck are very generally used for express traffic on many roads. In other European countries engines with a single pair of drivers are little used in express service, but there is an increasing tendency to the introduction of the American eight-wheel type of engines in these countries, and in fact, in nearly all countries, for express and ordinary passenger traffic.

As to the simplicity of the appearance of engines, that is a process that has been going on for some years in this country, and it would be hard to find a stricter simplicity of appearance than that of many of our recent engines. These engines, with boilers and cylinders clothed with Russia iron, and all other parts painted black, with little or no striping, and a minimum of lettering or numbering in gold leaf, represent much less "artistic" work than the English engines, with their paint of different colors and their striping and brass work. The older English engines, like the older American engines, had a certain amount of "architectural" ornament and gingerbread decoration. The use of the extension smokebox on English locomotives might lessen the cases of damage by fire from sparks from the engines, as noted in our issue of April 9, 1892.

The pertinence of the story about Sir Trueman Wood and the commisioner is not apparent, as we express baggage from 10 to 100 or 500 miles rather more frequently than 4,000 miles; and because the American system works well for both long and short distances in this country is no argument against its working well for short distances only in England. Many of our readers know, as we do, by experience, the discomforts of sorting out baggage from a pile thrown out of an English baggage car and strewn promiscuously about the platform.

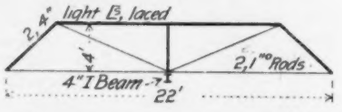
The point of most interest to American locomotive builders is that relating to engines for the English colonies, but the details we have published of the New South Wales engines, and the article on American locomotives in New Zealand, in our issue of Jan. 26, give more practical evidence in favor of American engines than our correspondent's remarks give against them. English builders offer to build "American" locomotives for the colonies and foreign railways, but the American features are frequently confined to such unimportant details as headlights, pilots, etc. With regard to English highways, our correspondent's remarks do not agree with the statements of an English engineer, experienced in traction engine practice, as given in our issues of Oct. 27 and Dec 1, 1892.

Finally, our correspondent refers to the well known mismanagement of some English railways, notably those in the southern part of the country, and we have several times commented upon and criticised such management, but it is not a matter of sufficient importance or interest in this country to warrant our taking up the cudgels for the English public, and American millionaires have something better to do with their money than to use it in trying to educate the sort of people our correspondent refers to; especially as they might expect little encouragement from the public who would benefit by the improvements they might effect. If this discussion on American and English locomotives and railways could be systematically taken up by unprejudiced and experienced men familiar with practice and conditions on both sides of the Atlantic, some good might come of it, but at present a large proportion of it seems to be borne by men unfamiliar with the subject, and therefore all the more unwilling to rush into print. There can be no doubt that it would be good policy for many English lines to get advice from American engineers and railway men familiar with practice and conditions on both sides of the Atlantic, but they seem to be indifferent to or jealous of such advice, and resent criticism, whether made understandingly or otherwise. That, however, is the affair of the English railways, and we do not intend to weary our readers with frequent articles on this subject.

LETTERS TO THE EDITOR.

LETTING CONTRACTS FOR HIGHWAY BRIDGES.

Sir: In your issue of Jan. 19 you give a cut of a "self-anchoring" suspension bridge. I think as a curiosity it could well be classed with a pin-connected span built about five months ago over a ditch in one of the Central states, of 22 or 23 ft. span. The diagram of the truss was as shown in this sketch.



The roadway was about 18 ft. clear, the truss was 4 ft. deep, the top chord and end post were two 4-in. light channels, laced. The bottom chord was two 1 in. round rods. The floor beam was a 4-in. I, the lightest rolled. The specification called for wooden stringers running from abutment to abutment!

It is superfluous, perhaps, to say that the only earthly use of this pin-connected "fake" was that of a railing, and that $10 per foot for such a shaky and ugly one as this, with the plank hub guard, is somewhat steep.

The stand taken by the Engineering News on the letting of highway bridges is a much needed move in the right direction. The present practice in the letting of that class of work is rotten indeed, and the resulting evils (namely, faulty design, the skinning of sections and details and the outrageous cost) are directly traceable to the class of men who are intrusted with the letting of the work.

The average county bridge commissioner, with his engineer, the county surveyor, whom you meet in a country district in the South and West, put one in mind of the old woman in the story whose son, a sailor, thought to interest her by a description of the flying fish. She could not believe this story; but when the graceless scamp told her that once when they had anchored in the Red Sea, upon heaving up the anchor they found one of Pharaoh's chariot wheels hooked onto the fluke, she knew it to be true, as the good Book told how the wicked king had been destroyed there with his chariots and hosts.

Thus it is with the highway bridge commissioners in the South and West. If you tell them that a good, solid riveted lattice girder is better and cheaper for a light highway span of from 30 to 80 ft., than one of the miserable rickety pin-connected low truss bridges so generally built for that length of span, they will think you are a liar and a fraud and very probably will tell you so. The same men, if you worm yourself into their good graces, and make your end top chord section about twice the weight of the center and confidentially hint that "That's the part of the bridge that the boys usually skin on," will think you're an honest man and award you the contract on the "merits" of the design, though your bid be one or two hundred high.

It is too frequently the case that the bridge agent finds it more profitable to engineer a good "bat" with the officials than to display his ability in the design of the work. This accounts for the fact that there are not a few pecuniarily successful bridge agents, the extent of whose knowledge of bridge design is enough

addition and multiplication to figure the weight of iron in the sections which they have guessed at!

With such a condition of affairs it is necessary for every concern to have its agent upon the ground. This, of course, means an expense which is met by pool combines. Now, since each comes in for a share of the pool, every agent will attend the letting, no matter whether his company wants the work or not, and therefore ofttimes the greater the number of competitors, the higher the price.

Occasionally the "boys" disagree and the letting goes to a 'fight," all bidding surprisingly low.

The lowest bidder has, perhaps, bid flat cost, and in order to squeeze a small profit out of the work he attempts to break again the already brilliant record at slicing sections and skinning details!

Were a reputable bridge engineer employed to award the contract and inspect the work, such monkey business would have to cease, and cutting sections and working in scrap iron would be a thing of the past. There would be, too, a marked difference in the plans submitted if true merit were to be an important consideration in the award.

A case in C—— came under my observation where the commissioners wished to award the contract to an agent who had submitted a miserable design, every section of which I know had been guessed at. Their engineer reported strongly against it and in favor of a really carefully prepared plan; so the commissioners called in a machinist as expert (?) and took his opinion in favor of it over the engineer's report!

The writer earnestly hopes that all bridge engineers will use their influence to bring about a radical change in the present method of letting highway work.

C. A. P. Turner, C. E.

New York, Jan. 21, 1893.

Sir: I read with pleasure your article in your issue of Jan. 19, relating to "Letting of Highway Bridge Contracts." It is a subject that has grown somewhat distasteful to the bridge men generally, because it is usually brought up by parties who are anxious to curry favor with some "board," to whom they have told the story of how the bridge business is conducted. Consequently, the bridge man gets all of the hard raps. You have always maintained a friendly feeling for bridge contractors and engineers, and I note with pleasure that yours is the first impartial statement I have seen on the subject which was not written by a bridge builder.

Your reference to legislation as being a possible way of removing the difficulties reminds me that only last year a party of engineers framed a bill, providing for the appointment of a state engineer and assistants whose duties were to be the examination of all plans and inspection of all bridges, new or old, new locations, foundations, etc., and no contract could be let without their supervision.

Perhaps the scheme would have been productive of much good; but it was gotten up by parties who were working for the appointments for themselves and friends. The bill never stood a show of success—because, first, it was not a subject of general interest; and, secondly, the motive of the pushers of the bill was apparent. But it would have been fought by bridge companies, for the same reason that legislation in this direction always has been, and will be: that there is too much liability of corruption when so much power is vested in one office, and "corruption" means work for one company and nothing for the rest. At best, it is not probable that any "engineer" placed by a political ring would know much about the business. "Plans on file" is a nuisance in the usual order of things. A fair sample of this practice, taken from my own experience, is as follows: Last year I was called to attend a letting in Adams Co., Ill., "plans on file," and when we found the plans they were as follows:

Length (1) span	72 ft. c. to c.
Height span	15 " "
Width, roadway	14 ft. clear
Live load	1,120 lbs. per lin. ft.
Dead "	600 " " "
Factor of safety	4
Panels	7 of 10.29 ft. each

A few of the errors in sizes are as follows: End braces and top chords were steel; two 9-in 15¼-lb. channels, and 12 × ⅝-in. plate, latticed under side; int. posts, two 7-in. 10-lb. channels, latticed both sides; lower chord, center panel, two bars, 2 ins. × ⅝ in.; floor beams, 8-in. 18-lb. I-beam; yoke hangers, ⅞ in. round iron, ends not upset for threads. The "engineer's"(?) estimate of the cost of this span was $250 below the lowest bid, at a "straight fight"; not only was there no "expense bill" added, but no item for profit either. In almost every case throughout the country where local "engineers" prepare the plans, a bridge company could build a structure of greater capacity and durability for 25% less money.

In our opinion, the difficulty in having engineers supervise or control bridge lettings arises from the fact that there are so few engineers who are capable of judging in this branch of engineering, I have known many engineers, professors, etc., to laugh at the idea that they were not competent to judge of plans, when if their "Carnegie" were taken away from them, they could not figure the strains to a certainty. If engineers for such work are wanted, the only thoroughly reliable ones, whom bridge men could trust, and who would not waste material or the county's money, would be men who had had actual experience in shops, good practical men. I am sure all bridge builders will be thankful when the day comes that they can give and take value received. But we suppose it must be in our business as in most others.

Under the present system, the real merits of a bridge plan are of little consequence. The "board" is usually a trio of farmers, who are politicians enough to get elected, but who are entirely incapable of comprehending anything about engineering. I have known one of the best engineers to go before a board, and "explain" by the hour, his "secants," "moments of inertia" and "bending moments," until half the audience would be asleep.

When "next" is called, in goes a fellow whose musty garret is only furnished with last year's quotation in pork, corn, or, perhaps, whiskey, and ten chances to one, the "whiskey" carries the day. How can you remedy this? All the way we can see is to educate men for members of the board.

One thing more: In several years' experience connected with the best known companies in the United States, in highway work, I have never gotten a contract because of the name of my company. It is the man in the field who meets the "board." If your man pleases them, the company is all right, and vice versa. W.

Sir: I have read your article on letting highway bridges, and appreciate and approve of your ideas therein, and they are so in accord with my practice that I herewith inclose two forms of specifications of iron work to show how they can be boiled down.

Yours respectfully, Jas. Owen.

Newark, N. J., Jan. 26, 1893.

Sir: I have read the article "The Letting of Highway Bridges" in your issue of Jan. 19 with great interest and satisfaction, and I beg to send you two circulars inclosed bearing on that subject, with some additional suggestions. I started this method of "Education" about July, 1891 (perhaps not entirely disinterested), but I intend to continue it, and to send out similar circulars annually, till a change for the better has been brought about. I am not afraid of the damage this method of advertising might do to my reputation, as I hope to be able to take good care of the same; and should it throw a shadow on my professional standing, I would only be too glad to bear it for the sake of "the cause;" as I am satisfied no reform has been brought about at any time without calling for sacrifices. The improvement in the business and social standing of engineers in this country will prove no exception to the rule.

I do not think that this desired reform is a thing of a far-off future, nor that insurmountable barriers are in its way. If a large number of competent and honest men of our profession can be brought to work together in the desired direction, acting upon conditions actually existing, and lend liberal support to each other in a broad and generous way, great progress can be made within a few years, especially if we are fortunate enough to see some able leaders rise from our ranks. In regard to the improvement of highway bridges especially, and in county engineering in general, I beg to make a few suggestions as follows:

1. Make Engineering News the focus of this movement after having secured the friendly support of other professional and of prominent daily papers.

2. Enlist membership for an association of men, familiar with this subject.

3. Avoid all red tape, and don't depend on legislation, at least not at this time; but create first a demand for good engineering work by educating the people for it. This is a matter of importance to engineers, and they must expect to do the heavy pulling themselves.

4. Print a small condensed pamphlet, embodying the principal ideas of your article "The Letting of Highway Bridges," supplemented by notes of actual experience of engineers in that line. This pamphlet should be written in a non-technical style so as to be understood by, and to command the interest of, men who are not engineers; and it should be indorsed by men of reputation in the profession.

5. This pamphlet should be distributed widely in every county of the United States; and prominent papers in all large cities should be asked to copy it.

6. Engineering News should endeavor to secure at least one subscriber in each county seat, if possible in the Commissioners' office; and where this is not possible it should be sent there gratis.

7. Engineering News should also try to secure news of all new bridge work in every county of the United States, and by this latter effort save to the bridge manufacturer the unnecessary enormous expenses in hunting up this information. Of course, the interests of other professional papers should have due consideration in this move.

8. At intervals additional articles pertaining to county engineering should be reprinted in popular style, with such cuts as would explain in a striking manner the exceptionally good or bad features found by actual experience with such work—(avoiding all personalities in criticism). This printed matter should also be systematically distributed in all counties of the United States.

9. This work should be accompanied by personal agitation on the part of engineers wherever a proper opportunity offers. We have to clear the field, and have hardly started the battle, and a false dignity at this stage will do no good!

10. Bridge agents should not oppose this movement, as the reform is sure to come in reasonable time, and besides the thrifty ones will find it easy either to turn manufacturers or engineers.

11. Of course, such a move would necessarily incur considerable expense, and I would gladly give $50 to a fund to be used in carrying out such work.

12. All engineering work should be done by engineers, and they should receive all proper credit and a just compensation for it. No professional calling can flourish if only a small part of the most difficult work is left to its members.

13. In cases where higher contract prices are obtained on account of the contractors furnishing the engineering service required, the engineers rendering such services should aim to secure in a proper manner the benefits of their education and knowledge as much as possible.

14. Consulting engineers should not be contractors, and they must consider personal integrity and unapproachable character of equal importance with competency.

I am satisfied that such a movement would increase largely the call for competent engineers ,and raise the standard of the profession, and that it would prove highly beneficial to the country at large.

Very truly yours, F. Felkel

Cleveland, O., Jan. 21, 1893.

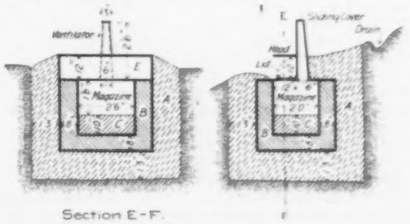
(We do not reprint Mr. Felkel's inclosures, as they are merely circular letters to county commissioners, and their substance is not necessary to his argument. We have discussed the subject further in our editorial columns.—Ed.)

A THAW-BOX FOR DYNAMITE.

Sir: I inclose herewith a sketch of a thawing-box employed at the new Croton Dam, believing it to be the first of its kind in actual use. The good results obtained so far show its practical value.

The space AA is filled with loosely rammed manure inclosing the outer box. The space BB, between the inner and outer boxes is filled with manure rammed hard, and the bottom of the inner box, to a depth of 10 ins. is filled with hard rammed manure. The remaining space in the inner box is large enough to accommodate easily 50 lbs. of dynamite. The ventilator is fitted with a sliding cover, thus giving an opportunity to regulate the rapidity of thawing. The lid of the magazine is covered by a hood to protect the interior when the lid is raised in stormy weather.

Everything being in readiness the powder is piled loosely in the magazine; the lid is closed and loose manure thrown into the space E. The ventilator, as a rule, is left slightly open, and the powder will be found in good condition in from three to five hours at a temperature of 32° F., and eight hours will thaw 50 lbs. at 0° F.



Thaw Box for Dynamite.

This thaw-box has several advantages; economy, simplicity and safety. The manure in the bottom of the magazine can be renewed at any time with little trouble; the renewal necessitating the thorough cleaning of this important part of the box. When the quantity of powder is small, the thawed sticks are pulled to the front of the box and the fresh powder placed at the back of the box.

The box has been in use for the past two months, giving complete satisfaction, and the entire credit belongs to Mr. J. J. Coughlan, one of the superintendents on this work. Engineer.

Croton Landing, N. Y., Jan. 31, 1893.

AUTOMATIC VS. MANUAL BLOCK SIGNALS.

Sir: The leading editorial in your issue of Jan. 28 discusses matter of so much importance to the railway world at large that I feel impelled to enter my feeble protest against one or two of your conclusions.

It is necessary first, however, to dissent from the

premises of Mr. O'Donnell, who writes from so handy and convenient a point as London, England, and whose letter you quote. We in America have so long been subject to the criticism of our English cousins, from Mrs. Trollope down to the man who described the state of Michigan after going through it in what he called a "sleepy car," that when they tell us a horse looks better without a tail, and that we do not know how to build a locomotive, we ought to accept the statement that we do not know anything about signals with calmness and conviction.

The office of the distant signal is so well understood in this country that it seems almost ridiculous to have to refute the statement that it (the signal) is an anomaly. The distant signal has long been known as having no existence except as it depends on a home signal with which it works. In the Westinghouse automatic system it is known and understood by officers and trainmen that if the block in front is clear and the distant signal is in a horizontal position, the home signal immediately in advance is also in a horizontal position, and vice versa.

The functions of a distant signal are those fulfilled by the first twinges of gout (to use an English simile), which warn a man not to "go so fast." If he disobey the injunction often enough in either case, the result is pretty certain.

It seems to me and many other simple and ingenuous Americans that an engineman who is not informed some distance in advance will of necessity frequently run by a danger signal while making his schedule time. The enforced disregard of a danger signal appears to us extremely bad practice, especially as there is a fixed rule against it which we do not see any substitute for. In fact, I believe this rule or one like it obtains in England.

The only anomaly in connection with a distant signal is its name, which for our sins we inherited from English practice and have now used so long that it seems almost impossible to disregard it.

So much for Mr. O'Donnell and his letter, which I should not have noticed had it not been used as a partial text for your editorial. His animadversions on the Westinghouse pneumatic system I do not much mind, as he is too evidently ignorant of the subject and (which is more to the point) cannot discuss the matter from an independent position so long as he is the paid employee of manufacturers of signal material.

Your statement that "absolute safety in the operation of trains cannot be insured by either the manual system or the automatic system alone" would have been equally true if you had said "or in any other way."

The question raised by you lies between the manual system (with all possible safeguards thrown around it) and a capable automatic system. I am well advised when I say that all our records show a most decided result in favor of even the poorest forms of automatic signals.

The human animal seems willing to exercise an enormous amount of ingenuity in "beating" something, which, if applied in legitimate ways, would insure a great and proper success, and up to date I know of no manual block system which cannot be "beaten" by an operator who cares to take the trouble. The grocery clerk "beats" the cash register, the street car conductor carries a dummy bell and "beats" the recorder which is hung around his neck; it is therefore not to the discredit of a lock and block system, when compared with other manual systems, to say that it can be "beaten," for they can all be "beaten."

Your suggestion of a device which will set the signal at danger on the passage of a train, and only permit the operator to lower it when the whole train has left the section, would not have prevented the Jersey Central collision any more than the automatic did, for your signal could and should have been lowered under the circumstances exactly as the automatic was.

The real question is not one between the manual and automatic systems, but is purely and simply a matter of discipline.

Will there be more mistakes made by the enginemen plus the block signal operators, or by the enginemen alone?

Nobody wishes to dispense with the enginemen, nor could they if they wished to, but a way has been shown by which the operators may to a large extent be done away with and a primal cause of trouble avoided.

The number of errors charged to automatic signals appears remarkably small compared to those made by manual signals, when the fact is considered that the mistakes of automatic signals are almost invariably known and reported, while those made by signalmen are only known when one train finds another train in a section which has been signaled clear, and even then are sometimes not reported from a false sense of friendliness on the part of the engineman, who does not want to get "Jimmie" into trouble.

I know personally of two cases at interlocking towers where an operator has deliberately disconnected a signal from its lever because it would not work, gone out to the pole, pulled the signal from there and caused a derailment in each case. The facts in either instance would not have been known if the wrecks had not resulted, and for that reason no one knows how many times it has been done; it is safe to say, however, that it has occurred many times, and will continue to occur so long as men and signals are combined.

In the case of automatic signals there is no object for any one but a deliberate train wrecker to do a thing of this kind, and the questions as to how a well designed automatic system is to be operated successfully are therefore those of maintenance and obedience to rule on the part of the enginemen. Once prove to the enginemen that their own safety, as well as that of the passengers, is involved in a disregard of a danger or caution signal, and the rest will follow.

I presume you remember the suggestion made by "Punch" in the early days of railroading, that if a member of the Board of Directors was chained to the front of each passenger train, some way to avoid collisions would be found by the management. It was not found convenient to adopt this plan, so far as I know, but the principle is closely allied to the one stated above.

This letter is written by me, not as the representative of any signal company, but as an American who is anxious that the lessons taught by our own practice shall have fair consideration in comparison with those of other nations whose manner of thought seems to be conducted on very different lines.

Very truly yours, Geo. H. Paine.

Pittsburg, Pa., Feb. 1, 1893.

(We fully agree with our correspondent that the results obtained from purely automatic methods of signaling have been extremely good, and go far to establish the belief that the use of manual operators can and will be wholly dispensed with in time. An editor cannot allow his hopes in this direction to influence his statements of what is, as indicated by the drift of current events; and, as we understand it, the general belief as to the issue, which rests upon the preponderence of evidence as weighed by those most concerned, is that the maximum of safety and convenience for very heavy traffic is obtained by the combined or "manuo-automatic" system. If one or the other alone must be trusted, there can be no doubt that the purely automatic block system is safer than the purely manual; and it may easily be, as our correspondent claims, that if everything were duly known and weighed, the balance of convenience would also be in favor of the automatic system. If so, it is bound to take the lead of all others in time, in spite of all temporary obstacles. It is so neat and simple in principle that every engineer and railway manager will hope so. We shall take pleasure in giving all records tending to prove that it is so. No system of signals can prevent accidents if engineermen wilfully disobey the signals. As Mr. Paine refers to Mr. O'Donnell's connection with a signal company, it is only fair to the latter to say that Mr. Paine also is connected with a signal company, being General Agent of the Union Switch & Signal Co., which controls the Westinghouse automatic system. Therefore it cannot be assumed that either of these gentlemen speaks with entire impartiality, but both of them are entitled to be heard as experts in signaling.—Ed.)

AN ENGLISH VIEW OF AMERICAN LOCOMOTIVES.

Sir: In reference to the articles on fast trains in your issues of Dec. 8 and 22, 1892, may I venture a few comments? I have been chiefly an onlooker in the wordy war as to locomotive merits, and have concluded "a plague on both your houses," for a more narrow trade-seeking set of arguments as have appeared on both sides I have never read. In America you appear to claim an unbounded superiority because, forsooth, in England we do not run heavy trains as a rule for freight or for slow passenger traffic. Much of our freight goes at a 40-mile speed, and as to our slow passenger traffic there is not much of this except on short branch lines, on which there is not enough traffic to fill even a short train; and our main line traffic is all so fast and so frequent that longer trains could not fill at such short intervals. As a fact, however, our fast trains are as heavy as American fast trains, and it is therefore not from lack of capacity in the locomotive that our slow trains are not also as heavy as American slow trains. You give particulars of a fast run on the Philadelphia & Reading R. R. with a Vauclain compound—a most creditable performance, but not one which in any way warrants the assumption that American engines are ahead of English engines. There is a point to which I would invite special attention, and I would refer you to a run made on the Northeastern Ry., of England, by one of Mr. Worsdell's two-cylinder compounds, No. 1517, with cylinders 20×24 ins. and 28×24 ins., a single pair of drivers 7 ft. 7¼ ins. diameter, and 175 lbs. boiler pressure. The highest speed attained was only 86 miles per hour, but the performance was better than that on the Reading even though the latter run shows a higher speed. The point to which I wish to especially draw attention is the relation of engine weight to total train load. In the American run an engine and tender of a total weight of 205,800 lbs. drew a train weighing in all 485,800 lbs. The engine thus makes up 0.424 of the total load. In the celebrated run on the Northeastern Ry. the engine and tender only weighed 194,264 lbs., and the gross load was 695,000 lbs. The ratio of engine load was thus only 0.28 of the gross train load. Further, while the American engine had a pair of 22-in. low pressure cylinders, the English engine had only the equivalent of a pair of 19.8-in. cylinders, and the stroke in each case was the same, 24 ins., but the English engine had a single pair of driving wheels 7 ft. 7¼ ins. diameter as against the American's four coupled 6 ft. 6 ins. Still again, the English tender weighed 7,712 lbs. more than the American tender, so that the English engine weighed alone only 104,552 lbs. as against the American engine's 123,800 lbs. In other words, the English engine hauled a train of 6⅔ times its own weight behind the foot plate. The more powerful American smaller wheeled coupled engine got away with a train not four times its own weight. Now you will admit that an engine which will do a maximum duty may be counted on for less arduous tasks, and we may take it that the two engines here in question exemplify tip top practice on the two sides of the Atlantic, and on the face of it the palm certainly belongs to the Northeastern engine. (This was by no means the maximum duty of the American engine.—Ed.). We may well inquire how it is that the English engine shows so very much better a result, seeing that the American was really a bigger engine in its cylinders, and mechanically ought to have shown a better record. Not for a moment do I propose to believe that because the Northeastern engine did better, that, therefore, an English-made 20-in. cylinder affords a better hold for steam than a 22-in. cylinder made in a more westerly longitude. But I think there is a good explanation all the same. In the first place, American track is but an improved quarry road unfitted for present day service. The rail bearing surface is insufficient, and the track generally not worthy of modern American practice. It is, perhaps, cheaper, but it is distinctly inferior to an English road with rails in chairs. As though not already weak enough you must pile on it enormous lumbering cars of great length, the weight of which you, with equal disregard, concentrate on a pair of short four-wheeled trucks. When an English line uses long cars they are at least carried on fairly lengthy six-wheel trucks. Thus, through the deflection of the track under the trucks you have your train always running up hill, and not content with this you use approximately-circular little cast iron rollers where we should use steel tired wheels of 42 ins. diameter.

Even your little tenders must be mounted on a pair of four-wheel trucks as though three single pairs with the middle pair flangeless, as used for the heavier English tender, were not ample for the load.

Having thus put all the resistance you can into the train you say what a mighty powerful thing the American locomotive is, can we not curb its awful power? And you cast about for means to do this, and a very neat method you have, for you add two ponderous side rods. Then you write a leader and say there are none so blind as those who will not see, and all the time you shut your eyes to the palpable open public fact that engines in England of less weight, smaller cylinders and bigger wheels, run trains relatively 50% heavier and on half the fuel than you run in America. Does this prove the English engine to be more powerful? No, it does not. It does not even prove that it is more economical in fuel for equal rates of expansion and, mark this, for equal drawbar loads. The truth is that Americans are paying enormously in coal for their cheap track and cheap little cast iron rollers, and then they abuse the English locomotive as a puny little thing because it does 50% more train hauling with only about 20 sq. ft. of grate surface. It may be freely admitted that English way trains and freight trains do not run so heavy as American trains of the same kind, but our fast trains are as heavy, and there are scores of them where a few only run in America. The question of train load is one of management into which I need not enter, but would merely say that the public would grumble if our expresses were reduced in number and run at longer intervals of double weight, but to say this cannot be done, in face of the known facts as above, is begging the question. (We have never said so, but it may be so judging from statements in some of the English technical papers.—Ed.).

Mr. Ely, of the Pennsylvania R. R., evidently has his eye on the English tender. Mr. Howard Fry showed in the engines of the West Shore R. R. that anglicizing such details as dome and sandbox covers by stripping off the moldings not only improved the appearance of the engines, but had no harmful effects, otherwise. His example has pervaded all later work, and it is certainly time for American management to inquire into their antiquated arrangements of track and the system of load concentration which robs the locomotive of its efficiency. The faulty track which is one cause

of so much resistance demands a large grate surface and a powerful blast, which in turn demands the ugly extended pouter pigeon front. Never were you more mistaken than when you credited your wonderfully low, long distance freight charges to your locomotives. Try running your freight at 40 miles speed, as even coal trains are often run here, and you will find that it is the low speed that does the thing. While I admit that our lines are shockingly managed, I do not overlook the fact that they do much more as a rule in the shape of collection and delivery than any American railways, and this, too, on a short haul. I have yet to see the American who in this discussion will, or can, recognize this truth, and cannot resist telling a little story in hopes it may be new to you.

When one of the Chicago Commissioners recently came over loaded to the brim with a disposition to find fault all he could in the effete old monarchy, he slopped over thus to Sir Trueman Wood when he had to enter the baggage scramble at Euston: "In my own country"—and here he made a gesture as though he would unfurl the stars and stripes and take possession of the country for Uncle Sam forthwith—"I can travel right ahead 4,000 miles and check my baggage through. Why, oh! why cannot I do this here?" "Because," answered Sir Trueman modestly, "we have no line here that runs right on so far." This little fact was the beginning of a new education for the carping commissioner. It lies at the bottom of all the differences in practice which you call inferiorities, because not exactly American, and much American argument seems based on the common school atlas, which presents England as large as the United States. On the basis of the school atlas presentation I think nothing of leaving New York after an early breakfast and dining in Chicago, doing two or three hours' business and sleeping in Tennessee the same night. Dissect that fact and you will perceive another reason for high freight charges; namely, that a high ton-mile rate for a little country does not necessarily lay so heavy a charge as a small rate in a big country.

Now, as regards suitability of locomotives in colonial work. My experience in the colonies convinced me that the English engines were too well finished and too finely fitted. For example, we had to line out the slide bars of the English engines which seized in the dusty weather, because they were fitted as they will run well at home where all slopes of cuttings and embankments are under grass, and as a rule fairly moist. The agent of the builders used exceedingly bad language about this very item. But we had no trouble after we had added the extra liner.

The English engines had wheels 6 ins. larger than the otherwise exactly equal American engine, and hauled over grades of 1 in 30 loads inversely proportional to the wheel diameter, but that was the fault of the man in the colony who ordered the English engine. Otherwise there was no difference in performance, and I am convinced there cannot be in fairly well built engines of either type. I might add that the English side rods were bright all over; the American bright outside only and black inside, but this did not seem to affect the workings of either engine for better or worse, and our track was good enough not to show any advantage in respect of ability to "work like an old hamper." You must really excuse my flippancy. I am not a salesman, but only a simple engineer, and it galls me to see arguments put forward in support of trade which are based on considerations entirely outside of engineering or mechanical lines. While I am sure that the relations of your track and rolling stock cost you a lot in fuel I do not wish to contend that you should alter this if it pays you in the long run, though I cannot see how it can do so, in face of the notoriously high ratio of engine to train load which seems to prevail with you. (We show in another column that it does not prevail.—Ed.).

I think it would help you to a truer understanding of English railway facts if you would picture to yourself how matters stand. To take England alone, omitting Ireland and Scotland, imagine half the population of the United States crowded into the state of New York. Build about 15,000 miles of railway, much of it four-track; collect all the United States manufacturers into the State and all the passenger mileage of the United States also. Lay about 16 tracks from New York city to Buffalo—(there is nearly that now.—Ed.)—and finally thickly intersect the state with good roads, equally good for either a bicycle or a traction engine, so that no village is off a first class highway, and bring the sea within 140 miles of the middle of the state or any part of it, and you will have an approximation to the state of affairs which exists here and understand why it is that train loads are not so enormous. From the figures given as to the relative weights of engines and trains I think you will perceive that it is certainly not due to want of capacity to do it that we do not run heavier way trains, and that conservative though you may be in many respects, you quite equal us in this virtue, for you cling to coupled engines very tenaciously, are very timorously increasing your wheel diameter and are throwing away a lot of fuel without even trying to modify your track and rolling stock resistances, which by your own showing must be too high; for I must refuse to believe that your locomotives are so badly constructed as to absorb in themselves the excess of capacity which they possess. Why cannot you do us a real service by criticizing the faults of management of our lines, especially of those in the south. A boy fresh from school would exhibit more intelligence in this branch than is shown on all the boards of directors in southeastern England. They do everything to discourage traffic which a most perverse ingenuity can suggest; frame rules and regulations than which they could not obtain worse by a public competition for the worst, encouraged by a prize. They do not even follow the lead of the northern lines, which pay 6 or 7% dividend, but drag along in a semi-bankrupt condition. What are American millionaires doing that they do not obtain a controlling interest in some of our lines and by ordinary attention to business reap a rich harvest from enhanced price of stock. One line has its 100 stock down to 16. True, it was a costly line to build, but it has entrances into London unequaled by any, and it never will pay a dividend until managed differently. I say differently instead of better, because with the lines I allude to any difference must be for better, worse is impossible.

In referring to your little cast iron rollers I do not wish you to set this down exactly as showing my opinion, but rather as an attempt to imitate, though feebly, the style and spirit which mark so much of American criticism of foreign practice; a criticism devoid of any comprehension of the differences due to environment. At the same time I would lay stress on the figures given with regard to ratio of engines to total load even though I perfectly appreciate the causes which make this ratio so unfavorable in your own practice. Understanding the cause, however, makes one think that it would at least be worth while the consideration of Americans whether it would not pay to reduce the evil rather than gloss it over by an unfair comparison of the weights of American way trains with English expresses. "Anglo-American."

London, Eng., Jan. 13, 1893.

(We have commented upon this communication in our editorial columns.—Ed.)

REDUCTION OF WATER CONSUMPTION BY METERS.

Some very important and interesting figures, having a direct bearing on the proper management of many water-works, have just been made public from Detroit. An average daily consumption of 204 gallons of water per capita in 1888 so taxed the capacity of the water-works that an enlargement of the system seemed imperative. It was found that the necessary improvements would cost $600,000, and, in view of the already extremely high consumption, the water commissioners very wisely resolved to try the effect of meters before enlarging the works, an expedient far too rare in this country. The success of this measure is shown by the fact that the total consumption of water in Detroit in 1892 was nearly two billion gallons less than in 1888, notwithstanding an estimated increase of population of 46,000, while the total operating expenses were $2,251 less in 1892 than in 1888. The number of meters in use increased from 48 in 1888 to 2,053 in 1892, the percentage of water metered from 0.67 to 13% of the total pumpage, while the average daily consumption fell from 204 to 140 gallons per capita, the intermediate steps having been 172 gallons in 1889, 155 in 1890, and 144 in 1891. At the close of 1892 practically all the manufacturing and business interests of the city were supplied through meters.

In the annual report of the Detroit Water Commissioners for 1892, from which the above figures are taken, Mr. L. N. Case, Secretary of the Commission, presents an interesting review of the reduction of water consumption in Detroit, which is a valuable addition to the general subject of water consumption and the use of meters.

Mr. Case opens his review as follows:

It is an established fact the world over that the consumption of water increases much more rapidly than the population, where no means are in use to keep a record individually of such consumption.

Various reasons, other than the true one, are often given for this increased consumption. A certain portion of this increase is often ascribed to the growth of the manufacturing and business interests of a community; but when it is considered that if a certain business interest will provide support for ten families and that the establishment of a similar interest will provide for ten additional families, it seems to be a fact that the pro rata of families in their relationship to business must necessarily remain the same, and that some other cause must be sought for.

This last argument is not quite sound because it applies chiefly to the population engaged in manufacturing. If a city were purely a manufacturing place, it would be perfectly sound; but when half or more of the population is engaged in commercial and professional pursuits it is another matter. Still, it has a certain force for all cities.

To show the rapid increase in consumption at Detroit Mr. Case presents the following table, which gives for each year since records have been kept the number of families supplied and the quantity of water pumped, both total and per family. Only the total pumpage is given for the year 1852, but for the 40 years, 1853 to 1892, the figures are complete, as follows:

Years.	Families supplied.	—Water pumped, galls.— Total quantity.	Per family.
1852	.....	235,840,275	.....
1853	4,283	303,531,743	70,868
1854	4,619	376,265,126	81,460
1855	5,282	542,807,364	102,765
1856	5,706	692,124,305	121,297
1857	6,189	697,190,523	112,650
1858	6,474	718,091,207	110,919
1859	6,794	782,112,587	115,118
1860	6,750	870,036,451	125,185
1861	7,128	895,129,423	125,579
1862	7,275	994,945,329	136,762
1863	7,690	1,035,798,043	134,734
1864	7,993	1,019,390,256	127,410
1865	8,251	1,040,514,887	125,675
1866	9,089	1,196,317,922	131,622
1867	10,242	1,425,535,230	139,186
1868	11,544	1,666,545,125	144,364
1869	12,774	1,946,810,325	152,400
1870	13,722	1,866,060,068	136,000
1871	14,896	2,300,150,605	154,414
1872	16,035	2,782,292,578	173,513
1873	17,019	3,198,393,948	187,930
1874	18,853	3,280,872,635	174,511
1875	19,606	4,207,454,260	214,600
1876	20,102	4,065,134,470	202,225
1877	20,345	4,213,239,790	207,090
1878	20,903	4,345,743,350	210,927
1879	21,541	5,129,509,110	240,348
1880	22,465	5,552,965,310	247,183
1881	23,749	6,543,127,068	270,722
1882	25,442	6,284,600,742	243,062
1883	27,415	7,379,327,788	269,170
1884	29,424	8,510,614,140	280,260
1885	30,533	9,970,829,580	326,886
1886	31,946	10,576,571,254	331,070
1887	34,486	13,168,859,808	381,860
1888	36,863	14,380,166,670	390,098
1889*	39,158	12,875,334,453	328,880
1890	41,467	12,120,944,532	292,360
1891	43,933	12,057,261,256	274,470
1892	46,400	12,276,612,482	264,582

* Commenced metering.

These figures show that the consumption per family increased from 70,808 gallons in 1853 to 390,098 gallons in 1888, an average annual increase of 12.86%. For the 10 years prior to 1888 the average annual increase was 8.5%. Since introducing meters, which began in 1889, the consumption has fallen from 390,098 gallons in 1888 to 264,582 gallons in 1892, an average annual decrease of 11¾%.

As a comment on the statement that the great city of London has a yearly family consumption of only about 55,000 gallons, while in our own country the family rate at Providence, R. I., is 75,000 gallons, Mr. Case says:

I cannot but believe that this column of figures, with its broad base of 390,000 gallons in 1888, is but a monument to the ever growing habit of wastefulness in man, and that the figures thereafter, with those of 1888 as a base, form another column which is fast becoming a monument to the efficiency of the meter system.

To illustrate the injustice of selling water under the usual schedule of rates, characterized as "guessing" at the consumption, Mr. Case introduces a table showing the monthly consumption, as ascertained by meter measurements, of certain consumers, A, B, C, etc., and the amounts each would have been assessed under the old plan, both the totals and rate per 1,000 gallons. The table, which Mr. Case says is to him a convincing argument for the use of meters, is as follows:

Consumers.	Monthly consumption, galls.	—Old rate of assessment.— Total.	Per 1,000 galls., cts.
A	583,500	$7.50	1 1-4
B	132,000	2.00	1 1-2
C	3,429,900	36.66	1
D	581,375	33.33	6 1-4
E	185,250	13.67	7 2-5
F	2,697,831	119.16	4 2-5
G	472,201	39.66	8 2-5
H	250,312	17.50	6 3-4
I	138,850	28.33	20
K	727,125	50.00	6 7-8
L	2,127,050	53.33	2 1-2
M	270,750	37.66	14
N	1,352,850	142.00	10 1-2
O	462,818	43.00	9 1-3

Commenting on these figures, Mr. Case says:

It will be seen by the above statement that but one of these consumers paid 20 cts. per 1,000 gallons, which is the rate charged when the quantity is estimated,

while one paid only 1 ct. per 1,000 gallons, or one-twentieth of the amount charged the former.

It is a well known principle of good government that the most careful espionage should be maintained upon the weights and measures that are in use for the purpose of measuring the quantities of articles that are for sale; and yet, in every community where the assessment plan is in operation, the people collectively are selling water to themselves individually by means of a measure that is more like an elastic bag than anything else, that expands for some and shrinks for others.

During the four years of restriction of consumption it is stated that a total saving of $235,408 has been effected by reduction of pumping expenses, and the saving of interest on $600,000, the cost of improvements required in 1889. This saving is calculated as follows:

The average increase in consumption per family from 1879 to 1888 was 8.56%. At this rate of increase the total amount of water pumped in the four years would have been 82,591,827,100 gallons, instead of the actual pumpage of 49,330,153,000 gallons, a saving of 33,261,674,000 gallons, or nearly 70%. The average cost of pumping a million gallons for the five years previous to 1892 was $4.45, and thus the total saving for the four years, owing to reduced consumption, was $148,014.

The debit and credit side of the meter account is presented in the report as follows:

	Dr.	Cr.
To cost of meters *.....$80,224		.....
By present value of meters.....	.....	$71,618
By pumping expenses saved.....	.....	148,014
By interest saved.....	.....	96,000
	$80,224	$315,632
Balance in favor of meters.....	.....	$235,408

* Including superintendence "and every other expense incident to their introduction."

It does not appear that the meters have been debited above, with interest on their cost from the end of each year, which would certainly be less than $15,000, still leaving $220,000 on the credit side of the account.

That the financial saving effected by the use of meters benefits all classes of the people is one of the most satisfactory of the results secured by the Detroit Water Board in its crusade against the extravagant waste of water. In the report of the board for 1891 the following statement was made:

> The cost of running the water department of any city depends largely upon the quantity of water which the works are called upon to supply. If the supply can be reduced, so can the cost. If the cost can be reduced, so can the rates for water.

While this statement is self-evident, its truth does not seem to have been grasped in many cities.

The revenue of the Detroit Water Board in 1892 met the operating expenses of the works and paid the cost of all construction and extension, said to have been large on account of the rapid growth of the city. The total water revenue for 1892, divided by the total number of families, gives a quotient of $8.67, against $10.21 as an average for the 10 years 1876 to 1885, inclusive, and $9.85, $9.36 and $9.34, respectively for the years 1886, 1887 and 1888. In the ten-year period 1876 to 1885, there was no reduction in the schedule of water rates, but in 1886 there was a reduction, while in 1891 the hose tax was abated and meter rates were reduced successively from 10 to 6 2-3, 5 and 3½ cts. per 1,000 gallons.

The 3½ cts. per 1,000 gallons applies to all water used above 3,000 cu. ft., or 22,400 gallons per month, all under that sum costing 6 2-3 cts. per 1,000 gallons, but 3,000 cu. ft. per month, or less than 750 gallons per day, is a low minimum for manufacturing and business purposes, as is shown by the fact that there were few consumers at or below this minimum. The average cost for all metered water in 1892 was 3.8 cts. per 1,000 gallons.

Regarding the common charge that meters discriminate against the consumer who pays meter rates, the report shows that in Detroit in 1892 the average rate for all metered water was 3.8 cts. per 1,000 gallons, and for all unmetered water 3.4 cts., the latter including the water furnished to the fire department, parks, fountains and other public purposes, which, if eliminated, it is stated, would make the rate for metered and unmetered water the same, or nearly so.

The above chronicles one of the largest and most complete experiments on the economic merits of meters which has yet been made. Its results would seem to be absolutely conclusive as respects any city situated at all as Detroit in regard to water supply, and there are still many such.

A NOTABLE CONCRETE BUILDING.

There are very few examples in this country of monolithic concrete structures with any claim to architectural excellence, although the possibilities in this direction have long been known to engineers. The best structures of this type which we now recall are the palatial hotels at St. Augustine, Fla., the Cordova, the Ponce de Leon and the Alcazar, illustrated in our issues of March 16, 1889. These buildings, of which Messrs. Carrere & Hastings were the architects, were remarkable examples of what can be done with concrete in the building of elaborately decorated structures.

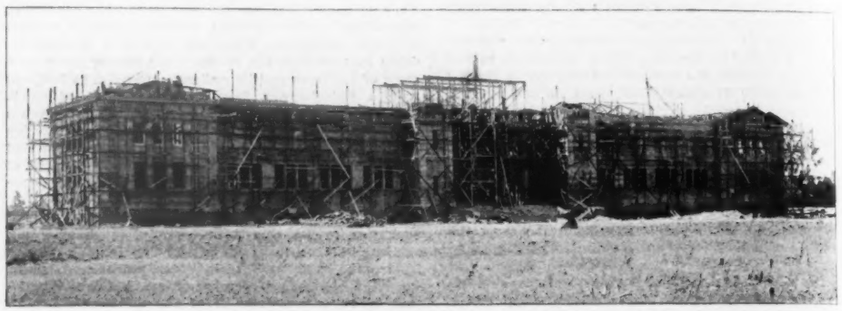


FIG. 1. MUSEUM BUILDING AT LELAND STANFORD, JR., UNIVERSITY, PALO ALTO, CAL.; MONOLITHIC CONCRETE CONSTRUCTION.

We illustrate herewith a concrete structure in a very different style of architecture, which was erected a year ago at Palo Alto, Cal., and forms the Museum Building of the Leland Stanford, Jr., University. The method adopted for placing the concrete in this building was that patented by Mr. Ernest L. Ransome; and the Ransome & Smith Co., 508 California St., San Francisco, were the contractors for the building.

FIG. 2. VIEW AT MAIN ENTRANCE, SHOWING METHOD OF CONSTRUCTION.

Fig. 1 shows the building nearly completed, and gives a good idea of its general outlines. It covers a ground area of about 300×50 ft. Fig. 2 is from a photograph taken at an earlier stage of the work, and shows well the system of wall and column construction used and the finish of the foundation courses. Fig. 3 shows the arrangement of the columns and piers which support the main floor of the building. The largest floor spans are 34 [illegible]. The exterior of the structure is finished with a smooth coating of mortar, which gives the wh[illegible] the appearance and color of brownstone. The in[illegible]terior finish of the halls is of marble. It has been the intention to make the building absolutely fire-proof, and wood is not even used for window frames.

In our issue of Sept. 8, 1888, we illustrated and described Mr. Ransome's patented system of combining concrete and iron in construction, which consists briefly in imbedding bars or rods of iron of rectangular section and twisted throughout their length in that part of a concrete beam or floor which is subject to tension. The twisting of the bar considerably increases its tensile strength, and the decrease in ductility which accompanies it is not important, since the iron cannot stretch much without breaking the concrete. The twisting of the iron of course gives the concrete a firmer hold upon it, and prevents failure through slipping of the rod in its concrete matrix. In constructing floors on this system, the floor may be made of an even thickness throughout; but the better way is to make it of paneled form, the iron strengthening rods being imbedded near the bottom of the ribs. In this way a light and very strong floor can be built, and a fine effect is obtainable with the paneled ceiling. To facilitate the use of this method of construction, formulas and tables have been prepared for floors of various depths and spans, both flat and paneled. This method of construction was used in the Stanford Museum, in the five-story building of the Academy of Sciences at San Francisco, with 50,000 sq. ft. of floor space, and in the Pacific Coast Borax Co.'s refinery at

Alameda Point, where 20-ft. spans carry loads of 200 lbs. per square foot.

The method of wall construction patented by Mr. Ransome consists of the use of vertical standards made in two halves, with a filling piece at each end, so that a slot runs nearly the length of the standard. As the wall is built up, these standards may be moved up continuously by removing the filling piece at the lower end. Fig. 4 illustrates

FIG. 3. CONCRETE COLUMNS AND PIERS SUPPORTING MAIN FLOOR.

one of these standards, and Fig. 2 shows them in use on the wall construction. Fig. 4 also shows the method of constructing a cornice by this system. With this method of construction a wall can be carried up with a very light expenditure for molding boards and framing, and can be kept plumb and of even thickness.

In constructing concrete buildings, of course great attention is paid to securing materials of uniform color and thoroughly mixing them to uniform consistency. At the Stanford Museum Building, Mr.

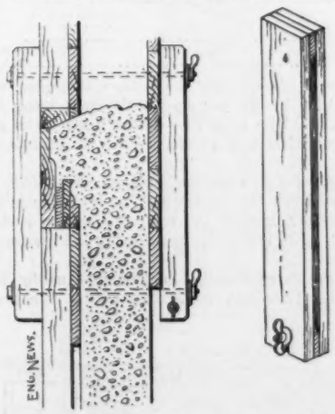


Fig. 4. The Ransome System of Supporting Concrete Walls During Construction.

Ransome used a concrete mixer of his own invention, and machine mixing is really essential to satisfactory work.

Besides the Museum Building, the girls' dormitory at Palo Alto was built of concrete by Mr. Ransome, and we believe other concrete buildings at the same place are contemplated. We are indebted for the photographs and information from which our description is prepared to Mr. Chas. D. Marx, Professor of Civil Engineering in Stanford University.

Two McDougall whaleback vessels are to be built at Liverpool, England, by the American Steel Barge Co., for the Cuban ore trade. Their combined carrying capacity will be 9,000 tons. It is stated that this is the beginning of the extensive construction of this type of vessel in European shipyards.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 124.)

(Gardner, Mass.)

The town of Gardner, Mass., is situated in the central part of the state, 65 miles from Boston. It is on the divide between the Connecticut and Merrimac rivers, all but a small part draining into the Connecticut River. The population of the town in 1890 was 8,424 and in 1880, 4,988. It is largely engaged in the manufacture of chairs. The waterworks were built in 1882 by the Gardner Water Co. The daily consumption of water is about 300,000 gallons. In 1889 a report on a sewerage system was made and sewers were built in the three following years.

The town is made up of four villages closely united, South, Depot, West and Center. Of these the West village is the most thickly settled and contains the most factories. The South is also thickly settled, and has a number of factories. The Center is strictly a residential part of the town. The Depot village is not thickly settled. South Gardner has a number of large ponds, and quite a stream flowing through it, which are utilized for sewage disposal. No sewers have yet been built in this part of the town, but in a short time something will have to be done. The outlet of Crystel Lake flows through West Gardner, and until sewers were built received the filth from the greater part of the village. At one point the water is held back by a dam, thus making a pond in which the filth settled. After passing this pond the brook runs by several large factories and is shortly joined by a brook from the Center and Depot villages. It then flows through unoccupied land, crosses Broadway and flows by the filter beds. Here it receives the effluent from the beds and finally it finds its way into the Connecticut River by way of Otter and Miller rivers. The brook from the Center and Depot villages is polluted to a considerable extent.

The scheme for a sewerage system comprehends one main and three small outlets. Only the main outlet has been built.

The State Board of Health, fearing that in time the crude sewage, if emptied into Otter River, might create a nuisance, or worse, ordered the town to purify the sewage before allowing it to flow into the river. Intermittent downward filtration was adopted. The main sewer is a 12-in. pipe which extends through West Gardner. The Center and Depot villages are drained by a 10-in. pipe which joins the 12-in. pipe about one-half mile from the filter beds. Work was begun in August, 1890, and was carried on during the summers of 1890-1-2. A greater part of West Gardner, the Center and Depot villages have been sewered.

The town is very hilly, has a large amount of ledge, and is, in places, quite wet.

The sewers were built in the ordinary way and need not be described here, note only being made of the fact that a gasket, wet in thin cement, was calked into the joints and that drop-manholes, shown by Fig. 63, were very successfully used.

There are 14 drop manholes, built wherever one sewer enters another at an elevation above the outlet greater than 1 ft. It was found to be cheaper to put in the drop manholes than to lay the higher of the two sewers at a lower grade. The channels in the bottom of the manholes were formed with brick and are of the same size and shape as the lower half of the sewer.

The separate system was used on account of its costing so much less than the combined and from the fact that the surface water can be easily and cheaply drained into the natural water courses without doing any harm.

There were in use, at the close of the summer of 1892, 5½ miles of sewers, 12 to 6 ins. in diameter, 128 manholes with perforated covers and 23 flush gates in manholes; also 139 sewer connections, of which 100 are from houses, 25 from business blocks, 10 from factories, with a total of 1,500 employees, and four from hotels. At the close of the summer of 1891 there was a total of 97 connections. The daily amount of sewage delivered at the filter beds is about 125,000 gallons. To reach the most available ground for a filter bed it was necessary to carry the outlet sewer down through a small valley and up onto a hill. This was effected by making the last 1,050 ft. of the outlet sewer of iron pipe, with a sag near the middle of 24 ft. A blow-off, discharging onto filter bed No. 50, used only in this connection, has been placed at the lowest point in the iron pipe. This is to be used only in case of stoppage. This gate has not been open for over a year and no trouble has arisen from solids collecting at this point and stopping the sewer.

The blow-off gate used is an 8-in. vertical lift gate, exactly like the one in use at the filter beds at Marlborough, Mass., shown on the inset, Fig. 11, in Engineering News of Aug. 25, 1892.

The iron pipe crosses the brook on a bridge and is housed in and packed in sawdust.

The outlet pipe discharges into a settling tank, shown in plan and section by Fig. 64. The tank is built of brick, with walls 12 ins. thick. It is divided into two parts by a 12-in. wall, built through the center, thus giving two compartments,

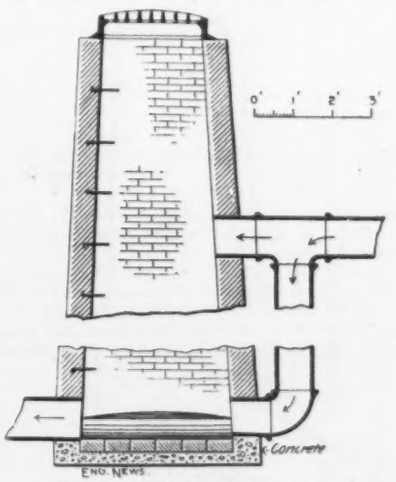


Fig. 63. Section of Drop Manhole.

each 20 ft. long, 7 ft. wide and 5 ft. deep. The sewage first flows into a wooden box, shown in plan by Fig. 65, and also by the dotted lines in the plan of the tank, Fig. 64, and is diverted into either tank by means of a swinging door. Stop planks to prevent floating matter from reaching the gate chambers are placed near one end of the tanks. The sewage is drawn off at the surface by means of pipes leading into the gate chamber. The flow into these pipes is controlled by iron gates, a sketch of which is shown by Fig. 66. The sludge is drawn off by opening similar gates, shown in plan at the bottom of the tank, Fig. 64, crude sewage being used to wash out the tanks. Extra pipes for future use have been built into the tank and gate chamber.

The flow from the gate chamber into the main carrier is also regulated by means of iron gates

like the above. The gates are raised or lowered by means of chains, which pass over pulleys and through the wall of the tank, and are worked inside the tank house. A large amount of solid matter settles in the tanks, and is discharged onto the sludge bed, through the sludge pipe, as shown in Figs. 64 and 67.

Iron gates, like those just described, are used in connection with flush manholes, the gates being lowered to cover the outlet pipe, or both outlet and inlet, if desired, and opened again after the manhole has been fitted from a pipe connecting with the water main.

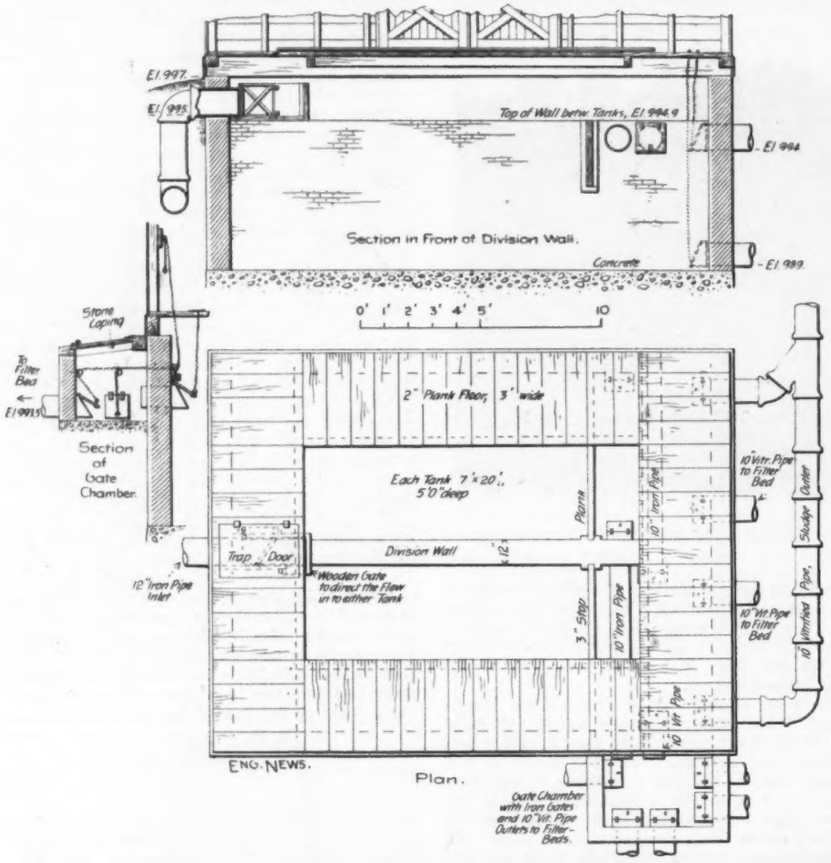


FIG. 64. PLAN AND SECTION OF SEWAGE SETTLING TANK, GARDNER, MASS.; McClintock & Woodfall, Engineers, Boston, Mass.

In constructing the filter beds, the surface was first leveled, the surplus dirt being used to make the banks, and the bottoms of most of the beds being formed in clay. They were then covered in gravel to the depth of from 4 to 5 ft., carted on from a bank south of the settling tank, after which the outlet for the effluent and the tile drains leading into them were laid. Then the banks subdividing the beds were built. The bottom of these banks extend 1 ft. below the surface of the beds.

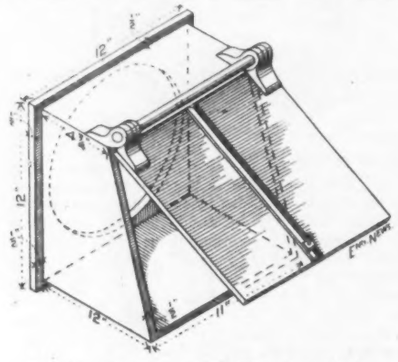


Fig. 66. Gates on Outlet Pipe from Tank.

All of the banks were then sodded. The 10-in. distributing pipes were then laid and connected with square wooden troughs, firmly fastened to cedar posts set in the edge of the bed. These troughs are covered, but every other cover is hinged so that the interior of the troughs can be examined at will. The troughs have an opening at each bed and by means of a board, sliding in grooves, the sewage can be directed on any bed, as desired. These troughs are from 2½ to 3 ft. above the beds and the sewage falls onto a piece of stone pavement which prevents the washing of the beds. The tile drains are from 4 to 5 ft. deep and 20 ft. apart and the banks are 2 ft. higher than the surface of the beds. The surface of the beds are level. Beds A and B were constructed by simply leveling the bottom and building the banks. No tile or outlet pipe was laid and the effluent simply soaked through the ground. An examination of the plan of the filter beds, Fig. 67, will show clearly their general arrangement. All of the beds except No. 51 discharge their effluent directly into the brook. The effluent from No. 51 is discharged into the woods, and is allowed to flow over the ground. The effluent is practically colorless and odorless and has caused no trouble in the brook. Overflows have been built so that the sewage cannot flow over the banks in any case. Very little trouble has been caused by the extreme cold weather, as the sewage finds its way under the snow and ice and is filtered through the gravel. The road from Broadway was built and the hill graded, greatly improving the general appearance of the field.

The areas of the several beds are as follows:

No. of bed.	Area, sq. ft.	No. of bed.	Area, sq. ft.
1	9,520	9.	3,240
2.	8,570	10.	3,850
3.	8,790	11.	3,850
4.	4,400	50.	2,500
5.	4,300	51.	2,300
6.	4,400	52.	3,370
7.	4,000	A.	5,000
8.	3,240	B.	11,000

Total, 82,330 sq. ft., or nearly two acres.

The above area does not include the space occupied by the main banks, but does include the division banks, the bottoms of which are only 1 ft below the surface of the beds.

Bed No. 51 was at first used as a sludge bed, but the odor arising from the sludge while drying, as well as from that which had previously been taken off and piled up near the bed, led to this bed being converted into a filter bed, and the construction of bed No. 52 for a sludge bed. Since this change no trouble has been caused by the odor, as this bed is farther away, and is over the brow of a hill and surrounded by woods. No trouble has been caused by the filter beds, as there is no odor arising from them that can be detected a few feet away.

Sludge beds should always be located as far as possible from the line of travel, and care should be taken to cover the sludge with earth or bury it after it is removed from beds. The sludge is allowed to remain on the sludge bed until it is dry, when it is removed and placed in piles and covered with dirt. The sludge is discharged from the tank, and the filter beds are cleaned every two to three weeks. The sewage is discharged onto the filter beds in the following order:

First day.

Bed No. 1,	from	7 a. m.	to	10 a. m.
" " 2,	"	10 a. m.	to	1 p. m.
" " 3,	"	1 p. m.	to	5 p. m.
" " 4,	"	5 p. m.	to	7 p. m.
" "A" and 5,	from	7 p. m.	to	7 a. m.

Second day.

Bed No. 6,	from	7 a. m.	to	9 a. m.
" " 7,	"	9 a. m.	to	11 a. m.
" " 8,	"	11 a. m.	to	1 p. m.
" " 9,	"	1 p. m.	to	3 p. m.
" "10,	"	3 p. m.	to	5 p. m.
" "11,	"	5 p. m.	to	7 p. m.
" "51 and "B,"	from	7 p. m.	to	7 a. m.

This has been found to give satisfactory results.

In summing up their description of the filter beds, the engineers state that the results have been entirely satisfactory; that there is no trouble to be feared from bad odors arising from the filter beds if ordinary care is used in running them, and that the sludge must be taken care of properly, as it is the odor from this that will give trouble, if any.

The cost of the filter beds and accessories, not including engineering and superintendence, was as follows:

Labor		$8,766
Vitrified pipe	684	
Tile pipe	238	
Wooden troughs	305	
Total cost of carriers and drains		1,227
Carting		26
Freight		13
Wood dams at Beds A and B		13
Iron gates and gate and gate chamber		99
Tank		600
Tank house		344
Miscellaneous		105
Total		$11,193

The cost of preparing the beds, with piping, was $10,046, or 12 cts. per sq. ft., the area being 82,330 sq. ft. The total cost of the beds, tanks and all accessories, was 14 cts. per sq. ft. of filtering area.

The general pipe system in place cost $40,530, including $1,719 for the 1,050 ft. of iron pipe in the outlet sewer, making the total cost of the system $51,723, not including engineering and superintendence.

The foregoing description was sent us by Mr. J. Leslie Woodfall, of McClintock & Woodfall, Boston, Mass., who were engineers for the sewerage system, and who also furnished the material for the illustrations.

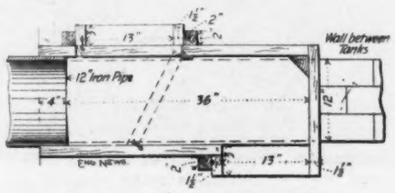


Fig. 65. Inlet to Settling Tanks.

The writer visited the Gardner filter beds on a warm and muggy evening in June, 1892, and also near the close of a hot day in the same month and year. Everything was apparently in good working order and wholly inoffensive.

At this time bed No. 51 was being used as a sludge bed, and on one of the visits sludge was being put onto the bed. The effluent from the sludge bed at this time was quite cloudy. It appeared at

the outlet of the underdrains in about three-quarters of an hour after it was admitted to the bed, but the tank full of sewage, as well as the sludge, had been drawn onto the bed, as was said to be the usual practice.

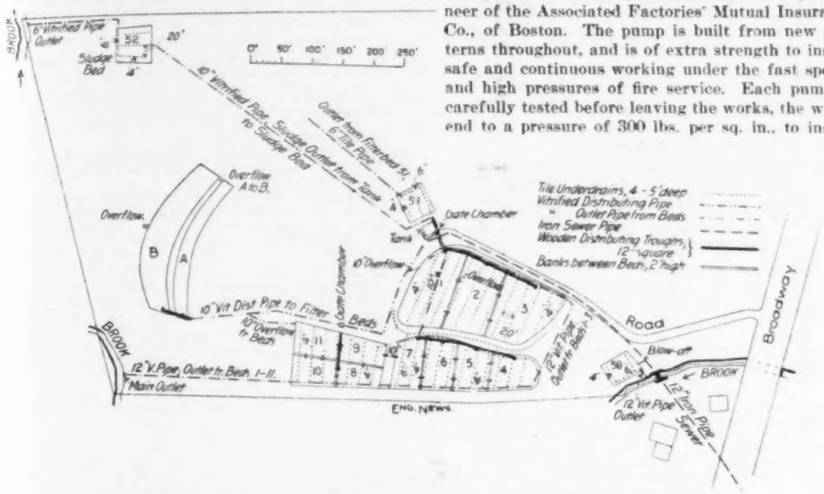


FIG. 67. PLAN OF SEWAGE FILTRATION BEDS; GARDNER, MASS.

The effluent from the filter beds was found to be very clean, and the brook which receives it gave but little evidence of the fact.

The attendant stated that the sludge was piled up in a heap, without dirt, when removed from the sludge bed, but it appears, from a statement above, that later in the season dirt was put upon the sludge.

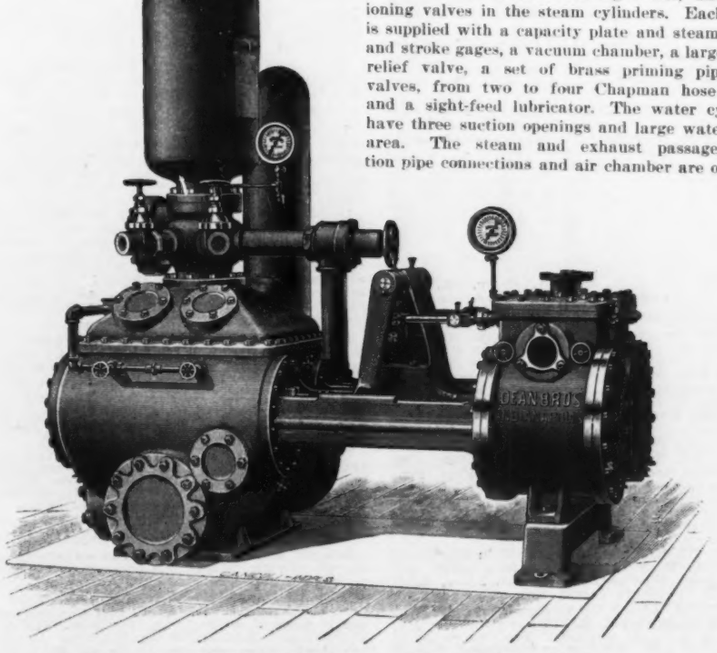
The sewerage system was built and still is under the direction of three sewer commissioners, Mr. Chas. W. Conant being chairman, and Messrs. R. L. Bent and Ezra Osgood the other two members. The beds are cared for by an attendant who lives in a house located on the disposal area, Mr. Jas. French having been the attendant in the summer of 1892.

THE DEAN DUPLEX FIRE PUMP.

The pump illustrated herewith has been specially designed by Dean Bros., of Indianapolis, to meet the requirements of the associated fire insurance companies, and also the specifications prepared by Mr. John R. Freeman, M. Am. Soc. M. E., Engineer of the Associated Factories' Mutual Insurance Co., of Boston. The pump is built from new patterns throughout, and is of extra strength to insure safe and continuous working under the fast speeds and high pressures of fire service. Each pump is carefully tested before leaving the works, the water end to a pressure of 300 lbs. per sq. in., to insure its conformity to the specifications. The following is a partial list of the sizes furnished:

No. of std. 1¼-in. fire streams, 250 gals. per min. each.	Capacity, gals. per min. Nominal full speed.	Exact, underwriters' rating.	Cyl. diams., ins. Steam.	Water.	Stroke ins.
1	320	321	12	6	10
2	500	503	16	8	10
3	750	707	16	9¾	10
4	1,000	1,007	18	10	12

These pumps have bronze water piston heads and followers, bronze removable liners in water cylinders. Tobin bronze piston rods and valve rods, bronze or bronze-lined stuffing boxes, and cushioning valves in the steam cylinders. Each pump is supplied with a capacity plate and steam, water and stroke gages, a vacuum chamber, a large water relief valve, a set of brass priming pipes and valves, from two to four Chapman hose valves and a sight-feed lubricator. The water cylinders have three suction openings and large water valve area. The steam and exhaust passages, suction pipe connections and air chamber are of extra size. The shells and boltings are made very heavy and strong.



DUPLEX FIRE PUMP; Dean Bros., Indianapolis, Ind.

The whole machine is designed to be an absolutely reliable stationary fire engine, which can be operated at a high speed without danger of breaking.

THE COFFIN TOUGHENING PROCESS.

The Cambria Iron Co. has had in use for some years a peculiar method of annealing steel, invented by John Coffin, an employee of the company, which is claimed to produce the important effect of raising materially the elastic limit of the metal without decreasing its ductility or ultimate strength.

In a test of this process reported by the company, a steel car axle was cut in two, and one half was submitted to the toughening process. A tensile test piece was then cut from each half 4 ins. in length and ½ in. in diameter, and the two were tested with the following results:

	Elastic limit. Lbs.	Ult. strength. Lbs.	Elongation. %	Reduction. %
Untoughened.....	30,000	71,520	24.50	51.5
Toughened.....	44,000	72,020	24.07	57.2

The Pennsylvania R. R. drop test requires a 4-in. axle to stand five blows from a 1,640-lb. weight falling 20 ft., the axle to rest on supports 3 ft. apart, and to be turned after each blow. For a 4¾-in. axle the height of drop is increased to 25 ft. In making this test in the early days of the process the manufacturers repeatedly carried the test to 50 blows in succession without breaking the axle. One axle tested to destruction stood 121 blows before breaking. The percentage of breakage of axles subjected to the drop test has been under 2½%.

It is claimed for the process that the ordinary method of annealing, while it removes the initial strains, does not change the structure of the metal, and leaves it crystalline in parts where it has received the most punishment in forging. It is even stated that the crystalline fracture of metal when suddenly broken indicates that a crystalline structure existed which should have been removed by the annealing process. We extract from the patent specification covering the Coffin process (No. 452,-051) the following description of its working:

The object of my invention is to correct an improper structural arrangement of the component molecules of masses of steel, and attain the maximum toughness and ductility in the said masses of steel. To accomplish this object I place the articles to be toughened in a suitable furnace and heat them to a certain temperature. This is the temperature at which the carbon has been supposed to change its chemical relation to the steel, and the result of this change is to break up the coarse crystalline or granular structure and leave the steel, while at this temperature, in an amorphorous condition. If now the steel be slowly cooled from this temperature, as has been heretofore the practice, a crystalline structure is re-formed, which, though it may not be as coarse as the previous condition of the steel, is yet of a weak crystalline order, there being little cohesion between the crystal faces. To retain the amorphous condition which is attained by heating to W, it is necessary to cool quite rapidly through a certain range of temperature extending from W to V. I will define W as a temperature showing a low orange color in the dark, and V as a temperature showing a clear red in the dark. Heretofore when rapid cooling to temperature V has been resorted to, to toughen articles of steel, this cooling has been performed in some liquid cooling medium; but in many cases the shape or size of the article to be treated is such that it is impossible to resort to this method of treatment—in the first place, on account of the difficulty of handling rapidly enough a large piece of hot steel, and, in the second place, the danger of cracking or causing excessive strains in a piece of irregular section. Therefore, in operating my present invention, after the articles of steel have been heated to temperature W, I expose them to the rapid-cooling action of cold-air currents directed against and around them. After temperature V is reached by this means, I discontinue the air-currents and close the furnace up tightly, and let the steel articles cool slowly until entirely cold. In some cases, where it is not thought best to use the air-currents, I remove the articles bodily from the furnace and let them cool in the open air from temperature W to V, when I place them in the furnace again and seal the furnace up.

The practical success of this process is indicated by the fact that all axles and locomotive forgings made by the Cambria Co. are treated by this process, and over 100,000 pieces have been subjected to it since its adoption.

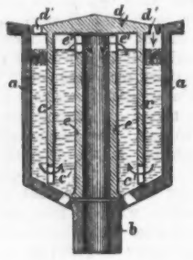
A SANITARY URINAL WITH OIL SEAL.

A new system of urinal sanitation, which has for the last three years been in use in parts of the public water closets at Vienna, Austria, and which is claimed to give perfect satisfaction, is described in the "Centralblatt der Bauverwaltung."

The urinals operated by this system are claimed to be entirely odorless, and flushing with water is entirely dispensed with. The apparatus, which is built into the floor of the closets, is shown in section in the accompanying cut. In the basin, a, is inserted a covered tube c. In the latter is placed the pipe e. The cover, d, is fitted with a number of annular openings, d'd', the tube c and pipe e have

openings c' and e', as shown. This apparatus or siphon is filled with water before using. The water is poured upon the cover d, entering the siphon through openings d'. When the liquid is at rest some oil is admitted, until it stands about 1 cm. (0.394 in.) thick on top of the water. When the urinal is being used, the urine enters the siphon by the openings d' and displaces its own volume of water, forcing it through the overfall opening e' into pipes e, and by which latter is connected with the sewer. The composition of oil, f, being lighter in weight than water, remains on top and thereby forms a perfectly air-tight seal. All parts of the water closets with which the urine comes into contact are daily oiled with this mixture, so that particles of urine can never adhere to the parts thus protected. This composition, as asserted, contains also disinfectant properties, and as the urine passes the layer f, it is thus disinfected.

Urinals constructed with the apparatus described are more cheaply constructed than those with automatic flushing. A public urinal with five stands costs, at an average, $675, while a urinal with the same number of stands and furnished with this apparatus only costs $500, while no expenses for flushing are incurred. Mr. W. Beetz, the patentee of this device, lately submitted to the municipal authorities of Vienna a proposition to rebuild all public urinals after his system, and also to clean and disinfect the same, if the city would in return pay him the cost of the water used otherwise for flushing. At present 1,457.5 cu. m. (264.18 gallons each) are used annually for this purpose, representing a round sum of $32,790. It looks as if this device had very meritorious features. The same principal is used in preserving unstable liquid from chemical change by means of oil; as, for instance, to preserve cans of limejuice, which readily ferments, for an indefinite time.



Urinal with Oil Seal.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

TEMISCOUATA.—This company has applied to the Canadian Parliament for authority to construct a line from Edmunston to St. Leonards, N. B., 20 miles long.

LEHIGH VALLEY.—Surveys are reported in progress for a line from New Brunswick to South Plainfield, N. J.

CENTRAL ONTARIO.—An application will be made to the Canadian Parliament for power to construct an extension from Corhill, Ont., to Bancroft, 17 miles.

CUMBERLAND VALLEY.—The Baltimore & Cumberland R. R. Co. has been organized by officials of this company to build a railway from State Line, Pa., to Cumberland, Md. The officers of the company are: Pres., H. G. Davis, Piedmont, W. Va.; Secy. and Treas., C. M. Handley, and Ch. Engr., Chauncey Ives, both of Chambersburg, Pa.

COLUMBUS, LIMA & MILWAUKEE.—Active preparations are reported in progress for beginning construction on the section of this proposed line between Lima and Defiance, O., 40 miles.

BALTIMORE & OHIO.—Work has been resumed on the line between Morgantown, W. Va., and Uniontown, Pa., 10.2 miles of which from Uniontown to Smithfield, Pa., were completed in 1892. The mileage remaining to be completed is 20.7 miles, the larger part of which is already graded.

CANADIAN PACIFIC.—This company has applied to the Canadian Parliament for an act to incorporate the Atlantic & Pacific Ry. Co., controlled by the Canada Pacific Ry. Co., with power to construct and operate a railway from Sault Ste. Marie, Ont., to Gaspe Basin, P. Q., passing through the Districts of Algoma and Nipissing, and following the valley of the Ottawa River as far as circumstances will permit, passing by or near the cities of Ottawa and Montreal, and running through the counties on the south shore of the River St. Lawrence, and with power to purchase or lease the Baie de s Chaleurs Ry., the Intercolonial Ry., the Great Eastern Ry., the Montreal & Sorel Ry., the Montreal Bridge, the Ottawa Valley Ry., and the Pontiac Pacific Junction Ry., and all railways or portions of railways constructed or authorized to be constructed which can be utilized as parts of the line, and to make running arrangements with any or all of the above-mentioned lines. Authority will also be asked for each and all of the above-mentioned companies to sell or lease their lines to the Atlantic & Pacific Co. The Intercolonial Ry., running from Liris to the Atlantic Ocean, is the property of the Dominion Government, while all the other lines mentioned have been largely subsidized by both the Dominion and Provincial governments.

BLOOMSBURG & SULLIVAN.—F. M. Leader, Ch. Engr. and Gen. Man., informs us that a line from Jamison to Gonaga Lake, Pa., 13 miles, has been surveyed and may possibly be put under construction this year.

KETNER, ELBON & SHAWMUT.—C. D. Williams, Supt., Ridgeway, Pa., writes that the surveys have been completed for the line from Glen Hazel to Shawmut, Pa., 25 miles, and that work will probably be begun this season.

Projects and Surveys.

PENNSYLVANIA, POUGHKEEPSIE & NEW ENGLAND.—A press dispatch states that a syndicate has secured control of the charter granted to this company in 1879, and will build a line from near Harrisburg, Pa., to Newburg, N. Y. The scheme also includes the construction of a bridge over the Hudson River and the building of a short line to connect with the New York & New England R. R.

BROADALBIN & AMSTERDAM.—The engineers report a very satisfactory line secured from Amsterdam to Broadalbin, N. Y. A meeting of the projectors will be held soon to consider the construction of the line. Ch. Engr., F. W. Brown, 34 North Main St., Gloversville, N. Y.

LEHIGH & PAVILION.—Chartered in New York to build a railway from Lehigh to Pavilion, N. Y., 5 miles. Incorporators, Robt. H. Sayer, South Bethlehem, Pa.; Wm. Cornell, Scranton, Pa.; C. F. Bissell, LeRoy, N. Y., and J. W. Taylor, Rochester, N. Y.

INDIANAPOLIS, LOGANSPORT & CHICAGO.—Surveys are making good progress on this proposed railway between Indianapolis, Ind., and Logansport, Ind., 70 miles. It is stated that the money necessary to build the line has been secured. Pres., E. N. Talbott, Logansport, Ind.

Southern.—Existing Roads.

FLOVILLA & INDIAN SPRINGS.—This company which operates a 3-mile dummy railway in Butts Co., Ga., is reported as preparing to build a 75-mile extension.

TREDGAR MINERAL.—This company has surveyed a line from Tredgar, Ala., to Taff, Ala., on the Chattanooga Southern Ry., and will probably put the line under construction this season. Ch. Engr., Geo. H. Montgomery, Jacksonville, Ala.

DECATUR, CHESAPEAKE & NEW ORLEANS.—A correspondent writes us that a meeting of the reorganization committee was held in Nashville, Tenn., on Jan. 31, and was in session about three days. The reorganization of the company was effected under the name of the Middle Tennessee & Alabama Ry. Co., and the following officers elected: Pres., J. Edward Simmons, New York, N. Y.; Secy., David Wilcox, New York, N. Y., and Vice-Pres. and Treas., Robt. D. Warren, Fayetteville, Ala. The general contract for building and equipping the road was let to J. T. Crass, New Decatur, Ala. This company was chartered in 1887 to build a railway from Gallatin, Tenn., to Aberdeen, Miss., 250 miles, and about 34 miles were built in 1889. Financial difficulties then overtook the company and no work has been done since.

LOUISVILLE & NASHVILLE.—The contract for building the proposed branch from Pineville, Tenn., to the property of the Log Mt. Coal, Coke & Lumber Co., has been awarded to Jas. Coyne & Co., Louisville, Ky.

OCONEE & WESTERN.—The 8½-mile extension east to Dublin, Ga., will be completed sometime in March. Work will, also, probably be begun on the extension from Hawkinsville to Grovania this season.

MIDDLE & EAST TENNESSEE.—Gen. Man. J. C. Rodemer, Gallatin, Tenn., informs us that surveys have been completed for the extension from Hartsville to Carthage, Tenn., 16 miles, and that construction will probably begin this season. There is also a prospect of some work being done on an extension to Gallatin, Tenn., from the C. & N. Junction, 8 miles.

Projects and Surveys.

DRY FORK.—Ch. Engr. John W. Moore, Jr., Hendricks, W. Va., writes us that surveys are now in progress for a line from Hendricks, W. Va., on the West Virginia Central & Pittsburg R. R., up the Dry Fork River to the mouth of Gandy Creek, 32 miles. The line will give access to a large body of timber owned by the company. The grades will be about 25 ft. per mile and the work very light.

STAR MT.—Chartered in Tennessee to build a railway from the Hiawassee River to the headwaters of the Connesauga Creek in Monroe Co. to open up the Star Mt. iron regions. Among the incorporators are Moses Greer, Jr., H. J. McCook and J. W. Caldwell.

GAINESVILLE, TALLAHASSEE & FLORIDA.—An attempt is being made by J. M. Mayo, of Ocala, Fla., to reorganize this company and carry the work to completion. The line was projected to run from Tallahassee to Gainesville, Fla., and thence west to the Gulf coast. The route has been recently surveyed and some grading done.

TAMPA & THONATASSA.—Chartered in Florida to build a railway from Tampa, Fla., to a point near Thonatassa Lake, Hillsboro, Co. Silas A. Jones, H. J. Cooper and H. L. Branch, Tampa, Fla.

NORTH CAROLINA.—A bill to incorporate the Winston-Salem & Charleston R. R. Co. has passed its second reading in the state assembly. The road is to extend from either Winston-Salem or Charleston through the counties of Davidson, Randolph, Montgomery, Stanley or Anson by Wadesboro, etc. The capital stock is not to exceed $5,000,000.——A bill incorporating the Carthage & Western R. R. Co. has passed its third reading in the assembly. The road is to extend from a point on the Carthage road to Currieville, in Moore County.——The bill to incorporate the Burlington & Northwestern R. R. Co., lately reported as introduced in the state assembly states that the line is to be constructed from a point in Alamance Co. to a point on the Cape Fear River in Yadkin Co., and through the Virginia line if desirable; capital stock $30,000, and not to exceed $500,000.——The legislature will be applied to for a charter for a railroad to run from Sanford to Smithfield by way of Moore, Harnett and Johnston counties.

ALABAMA.—A bill incorporating the Mobile & West Alabama R. R. Co. has passed the legislature.——A bill incorporating the Dauphin Island & West Point R. R. Co., and a bill to incorporate the Demopolis & Myrtlewood R. R. Co. have been introduced in the legislature.——A bill granting a charter to the Mobile & Florence R. R. Co. has passed the legislature, with an amendment requiring the road to pass through Greensboro.

Northwest.—Existing Roads.

GREAT WESTERN.—It is reported that this company proposes to expend $10,000,000 in improving its system, and that the money has been secured by a general mortgage on its property. The improvement mentioned consists of a second track from Alwein to Chicago, shops at Dubuque, Ia., and extensions to Sioux City, Ia., and Omaha, Neb.

CHICAGO, MILWAUKEE & ST. PAUL.—It is reported that this company will build a line from West Union to Hawkeye, Iowa, 11 miles.

SUPERIOR-DULUTH TERMINAL & TRANSFER.—This company will soon be chartered in Wisconsin. The incorporators are Day K. Smith and A. Harrington, of the Duluth Transfer R. R. Co., and H. H. McIntyre, of the South Superior Improvement Co. All the stock excepting a little held by Superior people is in the hands of the stockholders of the Duluth Transfer R. R. Co. The new company is a Superior branch of the Duluth Transfer Railway, and its organization was made necessary because the present company could not do business in Wisconsin. The Duluth Transfer R. R. Co. now has a bill before Congress providing for a bridge from Grassy Point to Superior. If this is built, the tracks of this company will end at the Wisconsin end of the bridge, and from there on will be known as the Superior-Duluth Terminal & Transfer R. R. The object is to make a complete terminal system for the whole head of the lakes.

DULUTH & WINNIPEG.—The report is in circulation that the Canadian Pacific Ry. Co. has purchased the property and franchises of the North Star Construction Co., which owns the Duluth & Winnipeg R. R. This road is projected to run from Duluth, Minn., to the International line, 250 miles; and about 100 miles, including branches, have been built.

CHICAGO, ROCK ISLAND & PACIFIC.—The Jansen extension from Lincoln to Jansen, Neb., 53 miles, has been completed. About 20 miles of the track were laid and most of the grading completed last year. The remainder of the track has been laid since Jan. 1, 1893, and with the exception of the finishing touches the road is ready for business.

DULUTH TRANSFER.—This company will build the following lines this season: West Duluth to Winnipeg Junc., 3¼ miles; 20th Ave. to 8th Ave. West, in Duluth, Minn., 1½ miles; West Duluth to New Duluth, 4½ miles; and in the city of Duluth, probably 6 miles. Pres. and Gen. Man., Day. K. Smith, Duluth, Minn.

Projects and Surveys.

ST. LOUIS, COLLINSVILLE & EASTERN.—Chartered in Illinois to build a railway from East St. Louis to Collinsville, Ill., with a branch to Venice, Ill. Among the incorporators are: Alex. Young, St. Louis, Mo.; Jas. Hannerty, Chicago, Ill.; John S. P. Gordon, Collinsville, Ill.

CHICAGO & NORTH SHORE BELT TERMINAL.—Chartered in Illinois to build a railway from a point on the Illinois-Wisconsin line, near Bluff Springs, to Waukegan, Ill. Among the incorporators are: Chas. H. Whiting, Robt. E. Ismonde and John E. Colvin, of Chicago, Ill.

RICE LAKE, DALLAS & MENOMINEE.—The preliminary survey has been begun for this railway from Rice Lake, Wis., to Cedar Falls, Wis.

Southwest.—Existing Roads.

LA PORTE, HOUSTON & NORTHERN.—An official writes us that grading and bridging have been completed on the main line from Harrisburg to La Porte, Tex., 17 miles, ready for the track, and that work has begun on the extension from La Porte to Clear Creek, 8 miles.

SPRINGFIELD, YELLVILLE & WHITE RIVER.—Grading will be continued this season from Winnerva to Yellville, Ark., 18 miles. In addition, a line from Yellville to Harrison, Ark., has been located, and another from Harrison to Springfield, Ark., partly surveyed. It has not been decided yet whether any grading will be done on the two last named lines or not. Ch. Engr., D. W. Pike, Kansas City, Mo.

Projects and Surveys.

RIO GRANDE & NORTHERN.—Chartered in Texas to build a railway from Van Horne, El Paso Co., Tex., to the Rio Grande. Among the incorporators are: R. E. Russell, John P. Ober, G. N. Marshall and others.

WACO, MOORESVILLE & AUSTIN.—This company will soon be chartered to build a railway from Waco, Tex., to Austin, Tex. The projectors are mostly citizens of Waco, Tex.

TEXAS.—A stock company has been formed by J. W. Orand, D. Landman, J. T. Morrison, and others, to build a railway from Whitney to Hillboro, 12 miles.——A company is to be chartered to build a railway from Marshall, Tex., to the Gulf coast, 200 miles. L. W. Lloyd, of Marshall, Tex., is interested.

Rocky Mountain and Pacific.—Existing Roads.

ROGUE RIVER VALLEY.—The ownership of this 5½-mile Oregon railway has changed hands, and it is stated that a 25-mile extension will be built.

SPOKANE FALLS & NORTHERN.—Pres. D. C. Corbin, Spokane, Wash., writes that this company now has 10 miles of railway from Northport, Wash., to the International line, under construction. Construction will also be begun soon on the Nelson & Ft. Shippard Ry., from the international line to Nelson, B. C., 60 miles, a charter and land grant of 10,240 acres per mile for which have been secured from the British Columbia government.

SHELTON & SOUTHWESTERN.—Work is now in progress on the extension from Shelton, Wash., to Summit, 6 miles.

Projects and Surveys.

COLUMBIA RY. & NAV. CO.—The contract for building the portage railway around The Dalles of the Columbia River has been let to McKinzie &

Glenn, of Spokane, Wash. Ch. Engr., Emery Oliver, The Dalles, Wash.

ASPEN & MOROON.—This company has been chartered in Colorado to build a railway from Aspen to Moroon Creek, Colo.

ELECTRIC RAILWAYS.

HALIFAX, N. S.—The Old Colony Trust Co., of Boston, Mass., will build an electric street railway.

ROCKPORT, MASS.—Chartered, Rockport Electric St. Ry. Co.; capital stock, $50,000; incorporators, Geo. R. Bradford, Eben G. Abbott, Jas. P. Meriden.

FONDA, N. Y.—Chartered, Fonda & Fultonville Electric Ry. Co.; capital stock, $100,000; incorporators—Wm. Niles, Fultonville, N. Y.; J. Hess, Fonda, N. Y.; John G. Ferris, Johnstown, N. Y.

NIAGARA FALLS, N. Y.—A meeting of the stockholders of the Niagara Falls & Suspension Bridge St. R. R. Co. will be held March 1 to vote upon a proposition to increase its capital stock from $250,000 to $750,000. The company has other extensions in view besides those already made, and will soon increase the capacity of its power house from 150 to 275 HP.

OCEAN CITY, N. J.—Chartered, Ocean City Electric R. R. Co.; Capital stock, $100,000; incorporators, Ezra B. Lake, Harry B. Adams.

BIRDSBORO, PA.—Chartered, Birdsboro St. Ry. Co.; capital stock, $12,000; Pres., G. Mortimer Lewis, Wilkes-Barre, Pa.

HAZLETON, PA.—Chartered, Northumberland, Bloomsburg & Scranton Electric Ry. Co.; Northumberland to Scranton, Pa.; capital stock, $500,000; Pres., John R. Coyle, Shenandoah, Pa.

MIFFLINTOWN, PA.—Chartered, Lewisburg & Mifflinburg Ry. Co.; electric railway from Lewisburg to Mifflinburg, Pa.; capital stock, $100,000; Pres., John J. Patterson, Mifflintown, Pa.

PHILADELPHIA, PA.—Chartered, Belmont Ave. Ry. Co.; electric street railway; capital stock, $18,000; Pres., Geo. B. Roberts, Philadelphia, Pa.

SHAMOKIN, PA.—Chartered, Shamokin & Elysburg Electric Ry. Co.; Shamokin to Elysburg, Pa., 8 miles; capital stock, $100,000; Pres., E. C. Hamilton.

DAYTON, O.—A company is to be chartered with a capital stock of $300,000, to build an electric railway. W. A. Mays, Dennis Dwyer, O. B. Brown, Miamisburg, O.

KALAMAZOO, MICH.—The General Electric Co. is seeking a charter for a street railway.

ALTON, ILL.—Chartered, Alton Electric St. Ry. Co.; capital stock, $250,000; Pres., A. M. Farnum, Vice-Pres., J. H. Porter; Secy. and Treas., G. H. Walbridge.

CENTRALIA, ILL.—An electric railway from Centralia to Salem, Ill., is proposed.

CHICAGO, ILL.—Chartered, North Side Electric St. Ry. Co.; capital stock, $500,000; incorporators, August Rieke, F. W. McNally, Wm. Kilpatrick.

NEW ORLEANS, LA.—The syndicate which has purchased the New Orleans City & Lake R. R. Co., the Crescent City R. R. Co., and the Judah Hart R. R. Co., will equip the lines with electricity. There are about 108 miles of line.

SARATOGA, CAL.—An electric railway franchise has been granted to Warren Olney, of San Francisco, Cal.

RENO, NEV.—An electric street railway is to be built.

FLORENCE, COLO.—Chartered, Florence Rapid Transit & Power Co.; capital stock, $100,000.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Central Elevated Ry. Co. has been organized in Chicago, Ill., to build an elevated railway in the downtown business district of the city. The capital stock is stated to be $5,000,000. Among the incorporators are David Kelly, J. H. Dwight, E. M. Fowler, Geo. E. Adams.

HORSE AND MOTOR RAILWAYS.

PHILADELPHIA, PA.—Chartered, Brownsville & State Line R. R. Co.; capital stock, $500,000; Pres., Henry D. Welch.——Chartered, Forty-Ninth St. & Westminster Ave. Passenger Ry. Co.; capital stock, $250,000; Pres., Geo. H. Roberts.——Chartered, Forty-second St. & West Park Passenger Ry. Co.; capital stock, $250,000; Pres., John L. Fry.——Chartered, Philadelphia & West Side Passenger Ry. Co.; capital stock, $250,000; Pres., Howard C. Potts.——Chartered, Marion Ave. Passenger Ry. Co.; capital stock, $50,000; incorporators, Jas. A. Campbell, of Clayton, Neb.——Chartered, Jackson & Porter St. Passenger Ry. Co.; capital stock, $50,000; incorporators, Frank S. Harrison, Wm. L. Kite.

CINCINNATI, O.—Sealed proposals will be received at the office of the Board of Administration, city of Cincinnati, until March 3, 1893, for the construction and operation of street railway.

HIGHWAYS.

PENNSYLVANIA.—The citizens of East Goshen township will vote Feb. 21 on the issue of bonds for $12,000 to improve the town roads.

GEORGIA.—The Commissioners of Fulton County have instructed the County Surveyor to prepare plans for a driveway between Atlanta and McPherson Barracks.

OHIO.—The preliminary survey for the Warrenton pike, between Steubenville and Warrenton, has been completed, and the engineers are now at work on the plans.

NEBRASKA.—The Commissioners of Douglas County will spend $150,000 for county road improvements. The special committee has decided to pave or macadamize Military, Dodge and Center roads.

IDAHO.—The lower house of the legislature has passed a bill providing for the construction of a state system of wagon roads in the counties of Boise, Idaho, Nez Perces, Lemhi, Custer, Latah, Shoshone and Kootenai, and providing for a bond issue of $135,000 to defray the expenses of constructing these highways.

BRIDGES, TUNNELS AND CANALS.

MANCHESTER, CONN.—A stone or iron bridge to cost $6,000 will be built at Union St.

OWEGO, N. Y.—There is talk of a bridge over the Susquehanna River to cost $23,000.

FRANKFORT, KY.—A bill has passed the Kentucky assembly authorizing the construction of a highway bridge over the Ohio River at this place.

RED WING, MINN.—The legislative committee of the City Council, has been ordered to receive the necessary state and federal legislation to permit the construction of a highway bridge across the Mississippi River. The bridge will be of iron, and designed for a weight of 60 lbs. per sq. ft. It will be 2,000 ft. long and will consist of a 360-ft. river span 55 ft. above high water; three 190-ft. spans, and one 110-ft. span.

DES MOINES, IA.—Bids will be received until March 3 for a four-span iron bridge. Cy. Engr., Jas. Carss.

NATCHITOCHES, LA.—Sealed bids, with plans and specifications for a 480-ft. swing bridge will be received until March 10. C. V. Porter, Pres., Cain River Bridge Co.

WATER-WORKS.

New England.

ENOSBURG FALLS, VT.—The village has voted to issue $15,000 in bonds for works, and elected five commissioners.

PITTSFIELD, N. H.—The water takers have passed resolutions asking the company to put in a filter at the brook near the reservoir, and that the sediment be removed from the reservoir.

HANOVER, MASS.—The Hanover Water Co. has been organized with Chas. H. Killam, Pres., and Edward H. Phipps, Secy.

LYNN, MASS.—Authority is being sought to take a supply from the Saugus River, and to issue $150,000 of bonds to pay for the same.

CROMWELL, CONN.—Authority to build works seems likely to be secured.

YALESVILLE, CONN.—The Yalesville Water Co. is proposed by Wm. A. Kendrick, T. H. McKenzie, Southington, and others. The company proposes to supply Yalesville, Tracy and South Meriden, and to have an authorized capital stock of $100,000.

Middle.

AMITYVILLE, N. Y.—The Amityville Water Co. has been incorporated; $30,000; Joel S. Davis, John E. Ireland, Amityville, Jesse C. Mills, Patchogue, and others; to supply Amityville and Babylon.

BELLEVUE, N. Y.—It is said that Wm. B. Turner will supply the village from works designed to supply a manufacturing plant in Schenectady.

BROOKLYN, N. Y.—A contract for three 10,000,000-gallon pumping engines for the Ridgewood station has been awarded to H. R. Worthington, the price being reported as $199,800, including pumps. A contract for two 10,000,000-gallon pumps for the Milburn station has been awarded to M. T. Davidson, for $84,350. Mr. Davidson is also building a pump for the Underhill Ave. station, to supply the new Prospect Park tower, for $22,750.

CORINTH, N. Y.—A company is proposed to supply this place and Palmer Falls, from Kendall Pond. John T. Rice, Corinth, Mr. and Mrs. Wm. H. Baker, North Creek, and Grace Wood, Glens Falls, are among the proposed incorporators.

NEW HARTFORD, N. Y.—R. V. Sherman, I. N. Terry, and others, have been elected water commissioners, and will probably secure plans for works, after which an election to vote bonds will be in order.

SCHENECTADY, N. Y.—R. D. Wood & Co., Philadelphia, have been awarded a contract for pipe at $24.30 per ton, the lowest bidders, Jackson & Woodin, Berwick, Pa., bid $26.20; Donaldson Iron Co., Philadelphia, $25.64; M. J. Drummond, N. Y., $25.50; Utica Iron Works Co., $25.48; Warren Iron Co., New York & National Iron Co., Scottsdale, Pa., $25.20. The contract for pipelaying was awarded to Joseph Clement, Schenectady, for $7,175.

ASBURY PARK, N. J.—The borough is seeking authority to issue $240,000 of bonds for improvements.

BELMAR, N. J.—The Coast Co. and the American Timber Co. have been incorporated "to supply water, heat, fuel and power, etc.," in Monmouth and other counties in New Jersey; $100,000 each; Hannah Butz, Wm. L. Keffer, Philadelphia, S. L. Gillin and H. H. Yard, Belmar.

KEYPORT, N. J.—It is reported that Hillpot & Ayres have a contract for laying about seven miles of pipe.

CLARK'S SUMMITT, PA.—The Clark's Summit Water Co. has been incorporated to supply South Abington township; $10,000; Treas., Wm. D. Boyer, Scranton.

ELIZABETH, PA.—The "Herald" says works should be built.

HELLERTON, PA.—W. F. Detwiller, J. T. Hortzog and Geo. B. Deemer constitute a board of trade committee recently appointed to report on building works.

HOMESTEAD, PA.—The question of buying a new pump has been referred to the new Council.

MIDDLEBURG, PA.—The Middleburg Water Co. has been incorporated; $25,000; J. N. Thompson, T. N. Harter.

Southern.

NEWBERN, N. C.—The Lewis-Mercer Construction Co., New York, has received a franchise for works.

WILSON, N. C.—It is said that a contract for works has been let.

OXFORD, ALA.—T. G. Bush and others, of Anniston, have obtained a franchise for works which may also supply Oxanna.

McMINNEVILLE, TENN.—Works are still projected.

MILLDALE, KY.—Works are reported as certain.

North Central.

GREENVILLE, O.—Contracts for the new works have been let as follows. Cast iron pipe and special castings, Ohio Pipe Co., Columbus, O., $27,084; pipelaying, Snyder & Williams, Dayton, O., $9,335; pumping station and chimney, F. M. Michael, Eaton, O., $7,700; pumping machinery and boilers, Hughes Steam Pump Co., Cleveland, O., $11,900; fire hydrants, Bourbon Copper & Brass Works, Cincinnati, O., $2,750; stand-pipe, Variety Iron Works, Cleveland, O., $3,780; masonry stand-pipe pier, F. M. Michael, Eaton, O., $5,772; stop valves, Ludlow Valve Co., Troy, N. Y., $900; stop boxes, Ohio Pipe Co., Columbus, O., $204; connection of driven wells, Irwin & Maher, Greenville, O., $887; total, $70,318. John W. Hill, Consulting Engineer, Cincinnati, O.

LEBANON, IND.—Geo. C. Morgan, Engr. and Contr., Chicago, has made a proposition to build water and electric light works, taking part of the cost in bonds and the remainder in yearly payments.

MARTINSVILLE, IND.—The people have voted for municipal ownership of the proposed works.

MICHIGAN CITY, IND.—An effort to secure independent works for the northern prison is being made by Warden French.

Northwestern.

ALVORD, IA.—Water and electric lighting plants are proposed.

SHELDON, IA.—It is reported that works will be built.

Southwestern.

CAMERON, TEX.—Address the mayor regarding water and electric lighting plants.

EL PASO, TEX.—An injunction has been issued restraining the city from issuing bonds for the proposed city works on account of indebtedness limitations.

CARBONDALE, COLO.—Works are desired. It is said that water is now supplied by wagons and in the summer through ditches.

Pacific.

PORTLAND, ORE.—Specifications for the new conduit, for which bids are asked in our advertising columns, were delayed by storms in the West, and did not reach this office until Monday, Feb. 13. They were immediately mailed to all who had requested them, and a telegram sent to Portland requesting that the date for receiving bids be postponed in order to give eastern contractors more opportunity to make estimates, etc. The officials reply that postponement is impossible, owing to the necessity of completing the work in 1894. The work includes the furnishing and laying of about 30 miles of 32 to 42-in. conduit and the building of three bridges. Mr. Jas. H. Harlow, Pittsburg, Pa., assisted in making surveys in 1886 for a conduit from Bull Run, the proposed new source of supply, and can give information on the subject.

IRRIGATION.

RIVERSIDE, CAL.—The Riverside Construction Co. proposes to build a canal 14 miles long with a capacity of 6,000 miners' inches. Pres., J. Irving Crowell; Secy., Geo. Cook; Engr., Jas. T. Taylor.

NEW COMPANIES.—Denver & Platte Valley Canal Co., Denver, Colo.; $500,000. Southern Oregon Water Co., Medford, Ore.; $250,000. Thermal Belt Water Co., Santa Paula, Cal.; $150,000. Orchard Irrigation Co., Boise City, Idaho; $200,000.

ARTESIAN WELLS.

MONMOUTH, ILL.—Cy. Clk. J. Arthur Stevenson informs us that bids will be received until March 6, for a second well, 8 or 10 ins. in diameter and 1,250 ft. deep. Address above or R. I. Young, Supt. W.-Wks.

SEWERS.

BOSTON, MASS.—The Metropolitan Sewerage Commissioners will receive bids until Feb. 25 for section 26 of the main sewer, in Winchester, Woburn and Stoneham; length, 5,750 ft.; average depth, 8.4 ft.; maximum external diameter, 38 ins.; masonry, 730 cu. yds. The lowest bid received by the Metropolitan Sewerage Commissioners for section 37 of the main sewer, in East Boston, was that of John Sheehan, Lynn, $45,691. The prices will be published next week.

CHELSEA, MASS.—We are informed by J. H. Stubbs, Cy. Engr., that the city will probably spend about $10,000 for sewers, but no work of importance is contemplated.

BUFFALO, N. Y.—The Board of Public Works will receive bids until Feb. 23 for ten contracts for 10 to 54-in. sewers.

HOOSICK FALLS, N. Y.—The contract for a sewer system has been awarded to S. B. Sears, Kingston, at $32,628. This was the lowest of 15 bids, the highest being $55,357.

JAMESTOWN, N. Y.—The Board of Public Works has recommended that the contract for a section of the proposed sewer system be awarded to W. H. Roberts, Pittsburg, Pa., at $42,607. The estimated cost of this section was $50,000, and the highest of the eight bids was $80,717.

KINGSTON, N. Y.—Important sewer extensions are proposed for the western part of the city.

NORWICH, N. Y.—Plans and specifications for a complete sewer system have been prepared by C. P. Bassett, Orange, N. J., and are now open to public inspection. The estimated cost of the entire system is about $100,000, but it is thought that $40,000 or $50,000 will provide for all that will be required for two or three years. The disposal for the near future will be into the river.

ONEIDA, N. Y.—The question of a system of sewers is to be presented to the taxpayers to vote upon. The plans were prepared by Walter F. Randall, and have been submitted to Emil Kuichling, Rochester, and approved by the state board of health. The estimated cost is $162,000, including about $25,000 for disposal works. For several years, however, it is proposed to convey the sewerage directly into the Oneida Creek.

ROCHESTER, N. Y.—The East Side Trunk Sewer Commission will receive bids until Feb. 20 for Section 8 of the main sewer; length, 4,571 ft. The contract for section 6 has been awarded to T. F. Moore, Buffalo, at $126,000. This is the first contract awarded to a non-resident. Plans are nearly prepared for the only remaining section of this sewer.—The following bids were received for the Main St. sewer: Weider & Voltz, $24,177; Robinson & Pond, $24,930; Brayer & Albaugh, $24,724. The estimated cost of this is $26,000 but owing to the few bids received it is reported that the work will be readvertised.

HOBOKEN, N. J.—A trunk sewer is proposed in Newark St. with an outlet at the Meadow.

MUNCY, PA.—It is proposed to call a special election to vote on the question of a sewerage system.

READING, PA.—The special Committee on House Sewerage, composed of councilmen and citizens, has adopted a report in favor of sewage disposal by downward intermittent filtration.

PORTSMOUTH, VA.—The committee on sewerage has accepted the report of W. T. Brooke, Norfolk, which recommends the adoption of the Shone system of sewerage, at an estimated cost of $100,000.

ATLANTA, GA.—The City Council has passed ordinances for sewers in 12 streets.

JACKSON, MISS.—We are informed by R. H. Bell, Co. Surv., that there is talk of putting in a system of sewerage. The city is located on rolling ground, with

a good-sized creek running through it, and this, it is thought, could be utilized as a main.

NEWPORT, KY.—Bids are asked until Feb. 23 for a sewer in Southgate St. B. R. Morton, Cy. Engr.

CLEVELAND, O.—Bids will be received until Feb. 23 for sewers in 13 streets. R. R. Herrick, Dir. Pub. Wks.

MONMOUTH, ILL.—The city council has awarded a contract to the Monmouth Construction Co. at $22,421. Eight bids were received, the highest being $35,407.

MILWAUKEE, WIS.—Plans for a sewerage system for South Milwaukee have been prepared by William Goodhue.

ST. PAUL, MINN.—The Clerk of the Board of Public Works has been instructed to advertise for bids for sewers estimated to cost $17,000.

DES MOINES, IA.—The city engineer is preparing plans for a 62-in. sewer, estimated to cost $132,584. The sewer will be built this summer.

ST. LOUIS, MO.—The city counselor is preparing a bill to be introduced in the legislature, providing that St. Louis Co. shall pay part of the expense of building a large sewer in River des Peres valley to carry away the sewage now drained into the River des Peres by residents of the county.

KANSAS CITY, KAN.—We are informed by C. A. Ellis, Cy. Engr., that he is preparing plans for a sewer system in the southern part of the city, formerly known as Armourdale. As this territory is practically level, quicksand near the surface, and the central part of the territory situated in a basin below high water of the Kansas River, many difficulties will be met with in building this separate system. The plans will be submitted to the council about Feb. 21, and if approved steps will be taken to let the contract at once. There will be about 5 miles of pipe sewers and about 1 mile of 10-in. cast iron pipe.

MOSCOW, IDAHO.—The question of issuing bonds for a sewer system is to be decided at the general election in April.

TACOMA, WASH.—It is proposed to issue sewer bonds for $200,000.

EUREKA, CAL.—A 4×5-ft. main sewer, 8,760 ft. long, is proposed, and we are informed by J. N. Lentell, Cy. Engr., that the work may be done this next summer.

LOS ANGELES, CAL.—The city clerk has been instructed to advertise for bids for two sections of the outfall sewer on the new route through Hyde Park and Inglewood.

SAN FRANCISCO, CAL.—The Golden Gate Valley Improvement Club has appointed a committee, which includes J. J. McGovern and R. D. Mattingly, to take steps to fix the grades and provide sewerage for the territory embraced in the Laguna survey.

STREETS.

BOSTON, MASS.—The park commissioners will receive bids until Feb. 20 for grading the parkway between Boston St. and the Old Colony R. R.; also for about 15,000 cu. yds. of filling, to be deposited upon the Dorchester parkway.

BROOKLINE, MASS.—The board of selectmen will receive bids until Feb. 20 for 8,000 lin. ft. of granite edgestones, 25,000 small granite paving blocks,and 23 granite catch basin covers and throat stones; also, until Feb. 27 for about 200,000 ft. B. M. of chestnut and spruce lumber for plank sidewalks.

CHELSEA, MASS.—We are informed by J. H Stubbs, Cy. Engr., that the city will probably spend about $30,000 for street improvements next season.

PAWTUCKET, R. I.—The highway department will receive bids until Feb. 18 for 200,000 granite paving blocks; the blocks to be 7 to 8 ins. in depth, 3.5 to 4.5 ins. in thickness, and 8 to 14 ins. in length, and delivered f. o. b. in this city.

NEW HAVEN, CONN.—The board of aldermen is considering a proposed issue of bonds for $300,000 for street paving.

BUFFALO, N. Y.—The lowest bids received Feb. 8 for paving were as follows: Queen City Paving Co., 3 streets, total bids about $21,000; P. B. McNaughton, 6 streets, about $80,000; German Rock Asphalt Co., 1 street, $9,474; Barber Asphalt Paving Co., 1 street, $9,635.

BALTIMORE, MD.—The joint committee on highways has decided in favor of paving in 12 streets with Belgian blocks. Several streets will also be paved with asphalt. The city council has appropriated $501,000 for street paving.

ATLANTA, GA.—The City Council has voted to pave Edgewood Ave. with small granite blocks on concrete, at an estimated cost of $26,000.

NEWPORT, KY.—Bids will be received until Feb. 23 for paving Fourth St. with brick. B. R. Morton, Cy. Engr. Plans have been prepared for paving two additional streets, at an estimated cost of $95,400, and the work will probably be advertised in about a month.

ASHTABULA, O.—The proposed paving of Main St. is estimated to cost $30,000, and that of Park St. $15,000. About 1,500,000 paving brick will be laid this summer.

CINCINNATI, O.—The board of administration will receive bids for paving, as follows: Feb. 18, brick in 4 streets; Feb. 27, macadamizing and bowldering, 1 street each; March 8, brick and granite blocks, 1 street each; March 11, brick in 2 streets.

CLEVELAND, O.—Bids will be received until March 8 for paving 4 streets with Medina block stone, 3 with Medina common stone, 4 with Trinidad sheet asphalt, and 5 with paving brick. R. R. Herrick, Dir. Pub. Wks.

DAYTON, O.—Additional paving has been ordered estimated to cost from about $87,000 to $120,000, according to the material to be used.

EVANSVILLE, IND.—The board of public works will receive bids until Feb. 25 for 95,000 sq. yds. of brick paving.

INDIANAPOLIS, IND.—The city engineer has prepared plans for 24 contracts for paving estimated to cost about $112,000.

DES MOINES, IA.—Bids will be received until March 2 for about five miles of paving with cedar blocks, Nicholson granite, brick and asphaltum. R. B. Dennis, Cy. Clk.

MOSCOW, IDAHO.—It is reported that the principal streets will be paved this next summer.

TORONTO, ONT.—The city engineer will receive bids until Feb. 21 for granite sets and scoria blocks.

ELECTRICAL.

BROOKLYN, N. Y.—The commissioner of city works has been authorized to advertise for proposals for public lighting for 1893.

WESTFIELD, N. Y.—The board of village trustees has fixed the price of incandescent lights at 70 cts. and 40 cts. per month for each light of 32 and 16 c. p.

MONTCLAIR, N. J.—A franchise for an electric light and power plant has been applied for by two or three companies organized by local parties. The town has a population of about 10,000, and a large demand for electric lighting by owners of private houses is assured, as the gas supply is of poor quality and high price. The franchise promises to be a valuable one to the company securing it.

MOUNT WASHINGTON, MD.—The plant of the Mount Washington Electric Light & Power Co. is to be enlarged and improved.

CATAWBA, N. C.—The Catawba Electric Power Co. has been organized to put in an electric power plant, using the water power of the Catawba River.

JASPER, ALA.—The Jasper Electric Light & Power Co. is seeking incorporation.

NASHVILLE, TENN.—It is proposed to grant a franchise to the Cumberland Electric Light & Power Co., and to contract with the company for electric street lighting. It is reported that the Western Electric Co., Chicago, Ill., will also petition for a franchise.

BAY CITY, MICH.—The Common Council has voted in favor of the city's furnishing electric light for commercial purposes. The present cost of street lighting is reported as but one-half the price formerly paid to the local company.

NASHVILLE, ILL.—The City Council has voted to pay $2,000 per year for electric street lights. A stock company has been organized, and a plant will soon be established.

KANSAS CITY, KAN.—The Merchants' Co-Operative Electric Light Co. has been organized by business men in Armourdale, and has petitioned for a franchise to construct and operate a plant.

HEMPSTEAD, TEX.—It is reported that an electric light plant will be put in by Amsler Bros.

ALAMEDA, CAL.—The Oakland Gas, Light & Heat Co. has applied for a franchise to construct and maintain a plant to furnish electricity for light and power.

RIALTO, CAL.—It is proposed to put in an electric plant in connection with the water-works system. Power would be furnished for the electric cars to San Bernardino and Riverside, and light would be supplied for public and private use.

GARFIELD, WASH.—It is reported that bonds will be issued to put in a municipal electric light plant.

NEW COMPANIES.—Ridgewood Electric Light & Power Co., Ridgewood, N. J.; $20,000; E. A. Walton, L. Smith, J. F. Carrigan. Ocean City Electric Light Co., Ocean City, N. J.; $30,000; E. B. Lake, Samuel Sampson, A. D. Scull. Catasauqua Light, Heat & Power Co., Catasauqua, Pa.; $69,000; Treas., James Thomas. Citizens' Electric Light, Heat & Power Co., Lancaster, Pa.; $100,000; Treas., A. A. Herr. Kennett Electric Light, Heat & Power Co., Kennett Square, Pa.; $20,000; Treas., J. C. Yeatman. Crescent Electric Light, Heat & Power Co., Chicago, Ill.; $100,000; J. R. Rickerdike, Burton Johnson, T. D. Huil. Augusta Electric Light & Mfg. Co., Augusta, Ill.; $16,000; to furnish light and power for the manufacture of brick, tile and pottery; Wm. Geim, B. B. Crain, D. P. Coffman.

CONTRACT PRICES.

GRADING AND MASONRY.—Jamaica Plain, Mass.—The park commissioners have awarded the following contracts to Secier Bros., the lowest bidders: Loam excavation, 34,000 cu. yds., 35 cts. per cu. yd.; earth excavation, 43,000 cu. yds., 28 cts. per cu. yd.; slope wall construction, 920 sq. yds., $4.90 per sq. yd.

PIPE.—Schenectady, N. Y.—Bids were opened Feb. 6 for 355 tons (of 2,240 lbs.) of 20-in. cast iron straight pipe, 137 tons of 16-in., 101 tons of 12-in., 136 tons of 8-in., and 9 tons of 6-in. The contract was awarded to R. D. Wood & Co., Philadelphia, Pa., at $24.30 per ton for the pipe, and 2.35 cts. per lb. for specials.

Cleveland, O.—Bids were opened Feb. 8 for about 4,412 tons of pipe and 200 tons of specials to be used by the water-works' department during the coming season. The lowest bid was that of the Lake Shore Foundry Co., Cleveland, $23.10 per ton for pipe, and $50 to $70 for specials. This price is somewhat higher than last year, when the lowest bid received in answer to the first advertisement was $25, but upon re-advertising the price dropped to $21.95 per ton. The price for 1893 is 35 cts. less than for 1891.

TRENCHING AND PIPELAYING.—Schenectady, N. Y.—The contract for trenching and pipelaying has been awarded to J. H. Clement, Schenectady, as follows: 20-in. pipe, 4,539 lin. ft., 65 cts. per lin. ft.; 61-in., 2,518 lin. ft., 50 cts.; 12-in., 2,750 lin. ft., 35 cts.; 8-in., 6,650 lin. ft., 25 cts.; 6-in., 600 lin. ft., 20 cts.; rock, $3 per cu. yd.

BRICK PAVING.—Easton, Pa.—We are informed by H. R. Fehr, Cy. Engr., that there were 12 bidders for the paving with brick in Walnut and South Fourth Sts. The prices ranged from $2.31 to $2.68 per sq. yd. for paving, but no contracts will be awarded until the brick have been tested.

Erie, Pa.—A large number of bids have been received for paving 17th St. with brick. The specifications call for a foundation of rolled gravel and sand, and for a ten years' guarantee. The lowest bid was that of C. R. Whittington, Erie, as follows: Paving, $2.09 to $2.59 per sq. yd., according to brick; manholes and catch basins, $50 each; 6 and 9-in. pipe, 75 cts. per lin. ft.; landmarks, $5 each.

MISCELLANEOUS.

STREET LIGHTING.—Trenton, N. J.—The City Clerk will receive bids until Feb. 21 for 400 street lamps of naphtha, gas or oil.

MASONRY, GRADING, ETC.—Cincinnati, O.—The Board of Administration will receive bids until March 10 for a concrete floor, retaining wall, masonry gate chamber, vitrified brick driveway, etc., at Eden Park pumping station.

DREDGING AND PIER EXTENSION.—Ottawa, Ont.—The Department of Public Works will receive bids until Feb. 21 for the extension of piers and dredging at Port Albert.

DREDGING, ETC.—The following work is being advertised by the U. S. Engineer Corps, bids to be received at the dates specified: Dredging.—Cocheco River, N. H., Feb. 20; Galveston Bay, Tex., Feb. 28; Buffalo Bayou, Tex., Feb. 28; Clinton Harbor, Conn., Feb 28; Wilmington, Del., March 2. Stonework.—Point Judith, N. Y., Feb. 24; Rough River, Ky., Feb. 25; Brunswick Harbor, Ga., March 4; Fort Hamilton, N. Y., March 6; Otter Creek, Va., March 9. Removal of Wrecks.—Philadelphia, Pa., March 7; Newport, R. I., March 8.

PAVING BRICK.—Washington, D. C.—The district commissioners have issued an order for the purchase of 600,000 vitrified brick for paving alleys, at $10.68 per thousand.

DREDGING.—Buffalo, N. Y.—The board of public works will receive bids until Feb. 23 for five contracts for dredging.

Baltimore, Md.—The city council has appropriated $20,000 for dredging the docks.

DISINFECTING PLANT AND BUILDING.—Philadelphia, Pa.—The board of health will receive bids until Feb. 21 for a disinfecting plant, and a building for the same.

LUMBER.—Boston, Mass.—The superintendent of streets will receive bids until Feb. 20 for spruce lumber.

GAS LIGHTING.—Boston, Mass.—The superintendent of lamps will receive bids until Feb. 24 for furnishing gas for public lighting.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Brooks Locomotive Works, Dunkirk, N. Y., have shipped a passenger engine to the Chautauqua Lake. The Rhode Island Locomotive Works, Providence, R. I., are building 313 eight-wheel, mogul and six-wheel switching engines for the New York, New Haven & Hartford, and 7 six-wheel switching engines for the Missouri, Kansas & Texas. The Pennsylvania R. R. and the New York Central are each building a powerful express engine for exhibition at the World's Columbian Exposition. The Baldwin Locomotive Works, Philadelphia, Pa., are building a two-cylinder compound Forney tank engine for the Chicago & South Side Elevated.

CARS.—The Madison Car Co., Madison, Wis., and the Barney & Smith Car Co., Dayton, O., are each building 250 freight cars for the Pennsylvania. The Murray & Dougal Co., Milton, Pa., is building 100 box cars, of 60,000 lbs. capacity, for the Lehigh & Hudson River. The Bilmeyer & Small Co., York, Pa., has an order for 30 passenger cars for the Illinois Central, and has delivered 2 passenger cars to the Tuscarora Valley. The Youngstown Car Works, Youngstown, O., are building side dump cars for the Lake Shore & Michigan Southern. The St. Charles Street Car Co., Belleville, Ont., has an order for 30 electric cars for Montreal. The St. Charles Car Co., St. Charles, Mo., has built 10 chair cars for the Missouri Pacific. The Duluth Mfg. Co., Duluth, Minn., has built 150 ore cars for the Duluth, Mesaba & Northern.

RAILS.—The Pennsylvania Steel Co., Steelton, Pa., has an order for 3,300 tons of steel rails for Cuba. The New York Central is laying its two freight tracks between Buffalo and Rochester with 80-lb. rails, to replace the present 65-lb. rails; the two passenger tracks are already laid with 80-lb. rails. The Pennsylvania R. R. has placed orders for 60,000 tons of rail.

THE IRON ECONOMY FIREPROOFING CO., Pittsburg, Pa., has been awarded contracts for the fireproofing for the Gardner Block, Toledo, O., and the Otto C. Wolf and Berrydal and Engel buildings. It has recently put in the fireproofing of the new public school building, at Pittsburg. Pres., C. A. Balph; Secy. and Treas., E. P. S. Wright.

THE AMERICAN HOIST & DERRICK CO., St. Paul, Minn., has opened a branch in the Carew Building, Cincinnati, O., under the charge of W. L. Manson.

THE STILLWELL-BIERCE & SMITH-VAILE CO. has been organized by the consolidation of the Stillwell & Bierce Mfg. Co., and the Smith & Vaile Co., both of Dayton, O., and will continue upon an enlarged scale the manufacture of the specialties heretofore made by these companies separately, including, "Victor" turbines, "Stillwell" feed-water heaters and purifiers, roller-mills and flour mill machinery, steam pumps and pumping machinery, linseed and cotton seed oil machinery, filter presses and hydraulic machinery, and power transmission machinery of all kinds. By this consolidation the company has a paid up capital of $1,000,000, and two of the largest manufacturing plants in the country.

JOHN MASLIN & SON., Jersey City, N. J., report that having greatly increased their manufacturing facilities, they are now offering the Maslin improved steam vacuum pumps at reduced prices, and have also reduced prices on Maslin's improved balanced ball neck pieces, air valves, flat and ball rubber valves, fitting old style pumps.

NEW COMPANIES.—Milwaukee Asphalt Paving Co., Madison, Wis.; $50,000; Henry Weber, F. Kraus and N. Ryan. Fayette Mfg. Co., Pittsburg, Pa.; firebrick; $25,000; Frank Williams and W. A. Stanton. Climax Road Machine Co., Marathon, N. Y.; $250,000; Walter A. Cook and Edgar L. Adams. Whipple Railway Tie Co., Jersey City, N. J.; $10,000; C. M. Cierrihew and George L. Record.

NOTICE TO CONTRACTORS.

ASHBRIDGE'S BAY IMPROVEMENTS, TORONTO, CANADA.

Tenders will be received by registered post, addressed to the City Engineer, Toronto (Canada), up to eleven o'clock a. m., on Tuesday, 7th March, 1893, for the construction of

A JETTY AND DREDGING A CHANNEL

in connection with the above improvements.

Plans and specifications may be seen, and forms of tender obtained on and after the 18th inst., at the office of the City Engineer.

A deposit in the form of a marked check, payable to the order of the City Treasurer, for the sum of 5% on the value of the work tendered for under $1,000, and 2½% on the value of the work tendered for over that amount, must accompany each and every tender, otherwise it will not be entertained. All tenders must bear the bona fide signatures of the contractor and his sureties (see specifications), or they will be ruled out as informal.

The Committee do not bind themselves to accept the lowest or any tender.

DANIEL LAMB,
Chairman of Committee on Works.

Committee Rooms, Toronto (Canada), February 14th, 1893. 7-14